IAOM Course Objectives:

The Thoracic Spine and Ribs

- Develop an understanding of the biomechanics of the Thoracic Spine and Ribs
- To gain an exact knowledge of pathoanatomy, physiology, and biomechanics of the thoracic spine and ribs.
- The ability to perform a concise clinical examination of the thoracic spine and ribs.
- Methodology for interpreting the clinical examination to reach a precise clinical diagnosis of the thoracic spine and ribs.
- The ability to perform effective treatment through an accurate understanding of surface anatomy and tissue physiology of the thoracic spine and ribs.
- The most effective techniques for mobilization of the thoracic spine and ribs.
- The ability to combine soft tissue and specific articulation techniques to affect total treatment of the thoracic spine and ribs.
- A framework for prescription of affliction-specific exercises for the thoracic spine and ribs.
- Understand Thoracic disc management
- Comprehend local examination and segmental testing.

This manual encompasses the entire course: online & live portions. All slides from the on-line and live portions are included in this manual.
**ONLINE: Diagnosis and Management of the Thoracic Spine**

Duration (in minutes) **8:15 H Total On-Line Contact Time**

| 27:55 | 1 | Thoracic Spine: Pathoanatomy (Thoracic Spine) | 1 |
| 39:35 | 2 | Thoracic Spine: Pathoanatomy (Thoracic Spine) | 2 |
| 41:34 | 3 | Thoracic Spine: Pathoanatomy (Thoracic Spine) | 3 |
| 19:12 | 4 | Thoracic Spine: Biomechanics |
| 41:18 | 5 | Thoracic Spine: Clinical Exam |
| 54:19 | 6 | Thoracic Spine: Clinical Exam |
| 19:33 | 7 | Thoracic Spine: Disc Management |
| 13:46 | 8 | Ribs: Pathoanatomy |
| 18:25 | 9 | Ribs: Clinical Examination |
| 32:23 | 10 | Thoracic Spine: Interpretation and Pathology |
| 43:03 | 11 | Thoracic Spine: Local Examination and Segmental Testing |
| 60:00 | 12 | Introduction to Strategic Communication - *Spine & Ribs: Pain Case Study: Bonus* |
| 86:15 | **Assessments**: each Video Module is followed by 5 Assessment questions |

**LIVE: Clinical Examination and Manual Therapy of the Thoracic Spine and Ribs**

**Day 1 – 8:30 H Total Contact Time**

| 8:00-9:15 | Highlights of Pathoanatomy Thoracic Spine | Lecture |
| 9:15-10:15 | Surface Anatomy | Lab |
| 10:15-10:30 | **Break** |
| 10:30-1:00 | History, Clinical Examination and biomechanics of the Thoracic Spine | Lecture & Lab |
| 1:00-2:00 | **Lunch (1 hour lunch)** |
| 2:00-2:30 | Pathology: Interpretation of the examination | Lab |
| 2:30-3:15 | Soft tissue management and acute disc | Lab |
| 3:15-3:30 | **Break** |
| 3:30-4:30 | Disc management and traction | Lecture & Lab |
| 4:30-5:00 | Pathoanatomy of the ribs | Lecture |
| 5:00-6:00 | Rib examination & treatment | Lecture & Lab |

**Day 2 – 6:30 H Total Contact Time**

| 7:30-8:00 | Questions-answers / Review day 1 | Lab |
| 8:00-9:00 | Rib treatment continued | Lab |
| 9:00-10:45 | Local examination: provocaton and motion testing | Lab |
| 10:45-11:00 | **Break** |
| 11:00-1:00 | Thoracic segmental soft tissue, mobilizations/manipulations | Lab |
| 1:00-3:00 | Case studies | Lab |
| 3:00-3:15 | Questions and Closing Remarks |
General Information

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FACULTY

Gail Apte, PT, ScD, OCS, FAAOMPT graduated from the Mayo School of Health Related Sciences, Minnesota in 1981. She completed certification by the IAOM in Orthopedic Medicine and Manual Therapy in 1992 and the Fellowship in 2008. In 2006, Dr. Apte completed her Doctorate of Science in Physical Therapy through Texas Tech University Health Sciences Center (TTUHSC). Dr. Apte is an assistant professor at TTUHSC, and maintains a clinical practice in Orthopedic Manual Therapy with a special interest in Chronic Pelvic Pain in Eugene, OR.

Esteban Azevedo, PT, ScD, COMT, graduated from the University of Arizona with a Bachelor’s of Science in Exercise and Sports Science. He received his Master’s Degree in Physical Therapy from Northern Arizona University in 2000. He completed IAOM-US certification in 2004, and completed his Doctorate of Science (ScD) from Texas Tech University Health Sciences Center in 2011. Esteban and his wife, Amy, own an outpatient physical therapy clinic, Modern Physical Therapy, in Kansas City, Missouri. www.modernpt.com Esteban has presented lectures on combining physical therapy with interventional pain management at pain conferences (Society for Pain Practice Management) on physical therapist and interventional pain physician teamwork. He has been teaching for the IAOM since 2005.

Nicolas Bellot, PT, COMT graduated in 2010 from a Physiotherapy School (IFMK) in Strasbourg, France. He completed his certifications in orthopaedic manual therapy with the IAOM-US in 2015. He contributes to the development of IAOM concepts in France and became assistant faculty for IAOM courses in 2015. Furthermore, he is a reviewer for the Journal of Manual & Manipulative Therapy and is enrolled in the Master of Science in Neuromusculoskeletal Physiotherapy at Brighton University in Great Britain. He assesses and treats patients with neuromusculoskeletal conditions in a private practice in Strasbourg, France.

Jamie Bergner, OTD, OTR/L, CHT, COMT, graduated from the University of Wisconsin-La Crosse with a Bachelor of Science degree in Occupational Therapy in 2000. She received her post-professional doctorate in occupational therapy with an elective track in education from Rocky Mountain University of Health Professions in 2016. She became a certified hand therapist in 2010, and obtained her certification through IAOM as a COMT in the upper extremity in 2015. She currently specializes in hand trauma at Vanderbilt University Medical Center, a level I trauma center in Nashville, Tennessee.

Jean-Michel Brismée, PT, ScD, OCS, FAAOMPT is professor in the Doctorate of Science Program of Physical Therapy at Texas Tech University Health Sciences Center (TTUHSC) in Lubbock, Texas. Dr. Brismée graduated from the Catholic University of Louvain-la-Neuve in Belgium with Bachelor of Science degrees in Physical Education (1982) and Physical Therapy (1985). He graduated from Texas Tech University in 1996 with a Master of Sciences in Sports Health and earned a Doctorate of Science degree in Physical Therapy from TTUHSC in 2003. He is the Director of the Fellowship Program and Chair of the
Research Committee of the International Academy of Orthopedic Medicine, Editor-in-Chief of the Journal of Manual & Manipulative Therapy and maintains clinical practice in outpatient orthopedics at University Medical Center in Lubbock, TX.

**John E. Cain, OTR, CHT, COMT** graduated from the University of Wisconsin, Milwaukee in 2001. He became a Certified Leduc Trained Lymphedema Therapist in 2004, a Certified Hand Therapist in 2007 and earned his COMT in 2010. Currently, John works with the Lakeshore Medical Clinic in Milwaukee where he specializes in upper extremity orthopaedic injuries and lymphedema patients. John has been an assistant instructor for the Hand and Upper Extremity Track with the IAOM-US since 2010.

**Frédéric Froment, PT, COMT** graduated in 2000 from a Physical Therapy School in Paris, France with a bachelor degree. He pursed his educational curriculum at the “Conservatoire des Arts et Métiers” in bioengineering, and at the Rene Descartes University Paris V and obtained a University Diploma in Pediatric Physical therapy in 2009. He is involved in the development of Orthopedic Manual Therapy in France with the IAOM-US and began assisting courses as assistant faculty in 2015. Additionally, he is pursuing a doctor of science (ScD) degree in physical therapy at Texas Tech University Health Sciences Center. Currently, Frédéric is Vice-President of the French Society of Physiotherapy and is member of the executive committee of OMT-France (RIG). He is associate editor of the Journal of Manual & Manipulative Therapy and maintains his private clinical practice in outpatient orthopedics in Chartres (France).

**Josué Gan, PT, COMT, MSc student** graduated in 2010 from a Physical Therapy School (IFMK) in Strasbourg, France. He completed his first year of master of science at the University “Joseph Fournier” of Grenoble (France). He earned his certification in orthopedic manual therapy with Manual Concepts (Australia) and IAOM-US in 2015. He is involved in the development of Orthopaedic Manual Therapy in France with the IAOM-US and began assisting courses as assistant faculty in 2015. Currently, Josué is member of the executive committee of OMT-France (RIG) and pursues his Master of Science (MSc) degree in Physiotherapy (Musculoskeletal specialty) at the University of Applied Sciences of Zürich (Switzerland). He lectures at the Physical Therapy School in Strasbourg and assesses/treats patients with neuromusculoskeletal disorders in a private practice in Strasbourg (France).

**Dale Gerke, PT, ScD, OCS, FAAOMPT**, earned his Bachelor’s Degree from Wisconsin Lutheran College in 1996, his Master of Physical Therapy from Concordia University Wisconsin in 2000 and his Doctor of Science in Physical Therapy from Texas Tech University Health Sciences Center in 2009. He currently serves as Assistant Professor and staff Physical Therapist at Concordia University in Wisconsin. Dale became an Orthopedic Certification Specialist in 2012 and a Certified Orthopedic Manual Therapist of the complete extremities in 2006. Dale completed his fellowship in 2017. He is an active contributor to multiple peer reviewed publications and presentations.

**Amy Hay, PT, ScD, COMT**, graduated from Northern Arizona University with a Bachelor’s of Science in Exercise and Sports Science. She received her Master’s Degree in Physical Therapy from Northern Arizona University in 2000. She completed IAOM-US certification in 2004. Amy completed her Doctorate of Science (ScD) from Texas Tech University Health Sciences Center in 2011. Amy and her husband, Esteban, own an outpatient physical therapy clinic, Modern Physical Therapy, in Kansas City, Missouri. www.modernpt.com

**Amy Houchens, PT, CHT, COMT**, graduated from the University of Wisconsin-Madison in 1996. After 9 years of general orthopedic and neurological outpatient practice, she began to specialize in hand therapy becoming a Certified Hand Therapist in 2010. She earned her COMT in 2013. Amy works full time for Therapeutic Associates in Bend, OR—a PT owned outpatient clinic. Her caseload is primarily hand and upper extremity with a mixture of post-operative and non-operative conditions. She began as an assistant instructor for IAOM in 2014.

**Mary Kremer, PT, ScD, MOMT** graduated from the Mayo School of Health Related Sciences, Minnesota in 1977. Ms. Kremer was certified by the IAOM in Orthopedic Medicine and Manual Therapy in 1991. She completed a Clinical Masters with Ola Grimsby in 1993. She is currently a senior therapist at the Institute for Athletic Medicine in Minneapolis, MN. www.athletic-medicine.org

**Omer Matthijs, PT, ScD, MOMT** graduated from the Higher Institute for Medical Professions, Gent, Belgium in 1975 and received his Doctorate in Physical Therapy from Texas Tech University in 2011. He has become a recognized researcher, practitioner, author and teacher specializing in non-surgical orthopedic medicine and manual therapy. He continues to treat patients in private practice in Austria & provides consultation services to physicians & PTs. He is co-director of the IAOM-EUR. www.iaom.de.

**Mike McGalliard, PT, ScD**, graduated from Texas Tech University Health Sciences Center (TTUHSC) with a
Masters of Physical Therapy in 1997. In 2006, he completed IAOM certification and in 2008, Mike received his Doctorate of Science in Physical Therapy from TTUHSC. Dr. McGalliard is now the Physical Therapy Program Director at Harding University in Searcy, Arkansas.

Robert Moss, PT, ScD, OCS, FAAOMPT, graduated from Texas Tech University Health Sciences Center (TTUHSC) with a Masters in Physical Therapy in 1998 and graduated from the Doctorate of Sciences Program in Physical Therapy in 2007. Dr. Moss certified with the IAOM-US in 2002 and completed the IAOM-US Fellowship Program in 2007. He owns Moss Rehabilitation Center in Springtown, Texas. www.springtownphysicaltherapy.com

Patty Nelson, PT, ScD, OCS, FAAOMPT graduated from the University of Minnesota with a Bachelor's of Science in Exercise Physiology and then completed her Bachelors of Science in Physical Therapy. She achieved her IAOM-US certification in Orthopedic Manual Therapy in 1993 and 1995. In 2008 she completed her ScD in Advanced orthopedic manual therapy from Texas Tech University and went on to earn her Fellowship in manual therapy in 2009. Currently she teaches in the Doctor of Physical Therapy Program at Eastern Washington University and pursues research related to women's health conditions.

Mirka Normand, OTR, MA, CHT, COMT, graduated with a Bachelor of Science in Occupational Therapy from Laval University in Quebec, Canada, 1991. She attended the Hand Therapy Fellowship program of Texas Women’s University and Baylor College of Medicine in 1999 and obtained her hand therapy certification (CHT) that same year. She completed her Advanced Master's degree in Occupational Therapy with Hand Therapy Specialty in 2003 at Texas Women’s University. In 2006, she achieved the IAOM-US Manual Therapy Certification for the upper quadrant (COMT). She is one of the creators and lead instructors of the IAOM-US Hand and Upper Extremity Track.

Thomas Osinski, PT, MSc, COMT graduated in 2009 from a Physical Therapy School in Paris (EFOM), France. He pursed his educational curriculum in orthopedic manual therapy with the COMT of Manual Concepts (Australia) and IAOM-US. He completed the first year of his master of science at the University “Joseph Fournier” of Grenoble (France) and obtained his MSc at the University “Pierre et Marie Curie” of Paris (France). He is currently pursuing his PhD on pain related to spinal cord injured patients. He is involved in the development of Orthopedic Manual Therapy in France with the IAOM-US and became assistant faculty in 2015. Presently, Thomas is Vice-President of the association OMT-France (RIG of IFOMPT). He teaches in two Physical Therapy Schools and maintains clinical practice in outpatient orthopedics in his private practice.

Valerie Phelps, PT, ScD, OCS, FAAOMPT graduated with a Degree in Physical Therapy from the University of Minnesota in 1981. She became an international instructor for the IAOM in 1994; at that time she also received recognition as a specialty instructor in manual therapy education by the German Physical Therapy Association. Along with being the Founder and current Education Director of the IAOM-US, she also instructs for IAOM courses in the USA and Europe. She is the Practice Director of an employee owned practice: Advanced Physical Therapy in Anchorage, the Mat-Su Valley, and Fairbanks, Alaska. www.aptak.com

Theresa Parry, OTR, BS, MS, COMT, is a 2012 graduate from University of Wisconsin – La Crosse with a Master of Science Degree in Occupational Therapy and a Bachelor’s degree in Psychology. Theresa completed the IAOM-US COMT of the upper quadrant in 2015. Theresa is a practicing therapist at the Hand to Shoulder Center of Wisconsin in Appleton, Wisconsin where she specializes in both conservative and postoperative treatment of orthopedic conditions of upper quadrant.

Ann Porreto-Loehrke, PT, DPT, CHT, COMT graduated from Marquette University in 1994. She became a Certified Hand Therapist in 2002 and completed IAOM-US certification for the upper quadrant in 2003. In 2007, Ann completed a post-professional doctorate of physical therapy (DPT) degree with a specialty in hand and upper quarter rehabilitation from Drexel University in Philadelphia, PA. Ann is the therapy manager at the Hand to Shoulder Center of Wisconsin, located in Appleton, Wisconsin. www.handtoshoulderwisconsin.com She has previously served as an item writer for the Hand Therapy Certification Commission and been a member of the Examination Committee. Ann is one of the creators and lead instructors of the Hand and Upper Extremity Track. She has presented at ASHT annual conferences, Wisconsin Hand Experience, Canadian Hand Conferences, Philadelphia Hand Conference, and Teton Hand Conference.

Denise Schneider, MPT, ATC, FAAOMPT graduated from Illinois State University with a Bachelors of Science in Athletic Training in 1997. She received her certification of Athletic Training in 1998. In 2002 she graduated from Midwestern University in Illinois with a Masters of Physical Therapy. She completed the IAOMUS certifications of the spine and extremities and is currently enrolled in the IAOM-US Fellowship program.
She is employed as a Physical Therapist and a Facility Manager at Accelerated Rehabilitation Centers in the Chicago-land area. She is actively involved with her company in other roles including mentorship, staff development, and program development. www.acceleratedrehab.com

**Becky Sherwin, MPT, COMT** graduated from Louisiana State University with a Masters in Physical Therapy in 1998. In 2011, she began her certification in the upper spine and completed testing for the lower spine in 2012. She is currently a Fellow candidate in the IAOM Fellowship program. She is employed by Melanie Massey Physical Therapy and is Director of the Adult Clinic in West Monroe, LA.

**Dustin Silhan, PT, ScD, COMT**, earned his Bachelor of Science in Health Services degree in 2005, his Master of Physical Therapy in 2007 and his Doctor of Science in Physical Therapy in 2012 from Texas Tech University Health Sciences Center. Currently, Dustin is a Therapist with BSA Outpatient Therapy Services in Amarillo, TX and working on a Doctoral teaching project: Diagnosis and Management of the Overhead Throwing Athlete: An Investigation of the Shoulder Complex and Kinematic Chain.

**Phillip S. Sizer, Jr., PT, PhD, OCS, FAAOMPT** graduated in 1985 from the University of Texas, Medical Branch in Galveston TX. He received a MEd in exercise science from Texas Tech University in 1993. He received a PhD with an emphasis in Motor Control from Texas Tech University in 2002. Along with serving as a Senior Clinician in an outpatient orthopedic clinic, he is a Distinguished Professor and Program Director of the Doctorate of Science Program in Physical Therapy, as well as Associate Dean of Research and Director of the Clinical Musculoskeletal Research Laboratory at Texas Tech University Health Sciences Center in Lubbock TX. Dr. Sizer is a reviewer for numerous peer-reviewed journals and serves as an Associate Editor for 2 peer reviewed journals: Journal of Manual & Manipulative Therapy and Pain Practice.

**Didi van Paridon, PT, MOMT** has been an instructor for the IAOM-EUR since 1980. Besides her private practice in Antwerp, Belgium, she teaches throughout Europe and the United States. She is co-author of the reference book series Manual Therapy of the Peripheral Joints [German, Dutch]. She has been president of the IAOM-EUR since 2005 when the founder, Dos Winkel, retired.

**Tiffany Tang, OTD, MBA, OTR/L, CHT, COMT, CEAS, CFCE**, has been a practicing occupational therapist since graduation from Hong Kong Polytechnic University in 1988. She became a certified hand therapist in 1995 and earned her Master in Business Administration in 2002. She received her post professional doctoral degree in occupational therapy in 2011, and completed IAOM-US certification in orthopedic manual therapy in 2015. She is also a certified ergonomics assessment specialist and a certified functional capacity evaluator. She is a Level IV clinician at California Pacific Medical Center and also teaches dental ergonomics in University of the Pacific Dugoni School of Dentistry in San Francisco.

**Megan Vaught, PT, ScD, OCS**, graduated from Texas Woman’s University. Ms. Vaught was certified by the IAOM-US in Orthopedic Medicine and Manual Therapy in 1995. She works in outpatient physical therapy at Abbott Northwestern Hospital/Sister Kenny Institute, Minneapolis, Minnesota.

**John Woolf, MS, PT, ATC, COMT**, received his Bachelor of Science in Physical Therapy from Northern Arizona University and his Masters of Science from the University of Arizona in Exercise Science with an emphasis in Biomechanics and Motor Control. He is the former Director of Medical Services for Athletics at the University of Arizona and currently the owner of ProActive Physical Therapy in Tucson, AZ. www.proactivept.com He serves as a clinical instructor in the University of Arizona Sports Medicine Fellowship Program and is the Administrative Director of IAOM-US.
INTERNATIONAL ACADEMY OF ORTHOPEDIC MEDICINE

If patients are not one-dimensional, how can a single course of therapy deliver healing? It can’t. That realization brought great minds in medicine and physical therapy together to create a powerful partnership for patient care.

The International Academy of Orthopedic Medicine (IAOM) was founded in 1978 by pioneering physicians and physical therapists in Europe and the UK who shared a vision that teamwork could transform orthopedic care for patients with non-surgical problems. The group organized dynamic courses, workshops, and lectures to explore an advanced method of clinical examination that employed selective tissue testing (via compression or tension), followed by establishing the most efficient treatment (of injection and/or manual therapy/exercise) based on specific patient selection.

Pain: a success story

The philosophy of the International Academy of Orthopedic Medicine continues to support a systematic approach to clinical diagnosis today, with the foundational paradigm that each structure of the musculoskeletal system has individual properties that do not change and are unique to that structure. Thus, when that structure is injured, the trauma causes pain in a certain region, often resulting in misleading symptoms in other locations. We have learned, however, that specific tests will evoke pain in a consistent pattern that clinicians can use to accurately diagnose their patients. Understanding pain as a diagnostic tool empowers both the clinician and the patient to take control of the healing process.

Healing without borders

In 1988, the International Academy of Orthopedic Medicine expanded to the USA, (IAOM-US), where research and instruction continue to build on the foundation of establishing an accurate clinical diagnosis that empowers clinicians to create the most effective plan of care. Taught at strategic locations throughout the USA, courses sell out quickly as the industry evolves and word of their demonstrated benefits spreads. Annual national and international forums draw bigger crowds each year, and cutting-edge techniques that improve patient outcomes continue to emerge. Fueled by this incredible momentum, the IAOM-US is bringing the methodology of clinical practice to Latin America and India in the near future.

Science + human interest

We teach healthcare professionals to go beyond orthopedic manual therapy, to reach past pain and treat people. IAOM courses give clinicians the tools they need to develop evidence-based treatment plans to manage or overcome pain and increase mobility, but it doesn’t end there. Using biopsychosocial and sensorimotor control models, we help visionary healthcare professionals to move patients further down the road to recovery - toward sustainable health and active, joyful living.

Help for the healer

What makes the IAOM different? In short, we feel your pain. We understand the unique challenges you face, and we are dedicated to providing solutions that enable you to grow and flourish in your practice. We’ll help you navigate the sea of literature by synthesizing the most critical information and providing it to you in a simple, dynamic format – so you can immediately and effectively apply it. More than a provider of continuing education, we are balm for today’s busy healer—a strategic partner you can count on for the life of your career.

Evolving together

As the industry continues to evolve, the IAOM is committed to keeping healthcare professionals ahead of the curve through certification opportunities, interactive courses on emerging techniques, and a robust menu of learning aides including textbooks, DVDs, and Healers Edge—a compelling, click-able newsletter available to healthcare professionals worldwide. We’ll help you organize a wealth of musthave tools, so you’re always on top of your game. We share your passion for providing patients with differentiated care and optimized outcomes—imagine what we can do together!
It is well known that MRI, CT scan, and radiographs often depict “abnormalities” that are misleading: surgery is performed, and the pain remains unchanged afterward. Several studies have confirmed that the clinical examination is more effective than imaging. For instance, using simple but specific tests (some compiled, some developed by the IAOM), it is possible to differentiate between a muscle lesion, a bursal irritation, a labral tear, a tenosynovitis of the biceps, or an arthropathy of the shoulder joint, as being the source of an individual’s pain.

Following the same philosophy (of staying true to anatomical findings and recent research), IAOM instructors have developed and refined treatment techniques that consist of manual therapy and appropriate affliction-specific exercise programs. This affords the clinician an effective, comprehensive, and diagnosis-specific treatment plan for every non-operative orthopedic disorder.

RESOURCES:
A DVD series (set of 12) by IAOM-US faculty is now available. Authored by Phil Sizer, Jean-Michel Brismée, Greg Dedrick, and Valerie Phelps, each DVD will address examination techniques, surface anatomy, and soft tissue and joint mobilization treatments for a specific joint.
In addition to several books in Dutch and German, Dos Winkel, Omer Matthijs, Didi van Paridon, and Valerie Phelps have published the following books in English:
Diagnosis and Treatment of the Upper Extremity. Aspen Publishers; 1997. (No longer in print.)
Diagnosis and Treatment of the Lower Extremity. Aspen Publishers; 1997. (No longer in print.)
Diagnosis-Specific Orthopedic Management of the Hip OPTP 2007 Diagnosis-Specific Orthopedic Management of the Knee OPTP 2009
All of the above resources are available from OPTP (1-800-367-7393) or via www.optp.com.

Book Chapter

Peer Reviewed Journal Articles


Sizer PS, Brismée JM, Cook C Medical Screening for Red Flags in the Diagnosis and Management of Musculoskeletal Spine Pain. Pain Practice, 2007; 7(1):53-71. ABSTRACT


Childs JD, Whitman JM, Sizer PS, Pugia ML, Flynn TW, Delitto A A Description of Physical Therapists’ Knowledge in Managing Musculoskeletal Conditions. BMC Musculoskeletal Disorders. 2005;17;6:32. ABSTRACT


Sizer P, Phelps V, Gilbert K Diagnosis and Management of the Painful Shoulder. Part 2: Examination, Interpretation and Management. Pain Practice 2003;3(2)152-85. ABSTRACT


James CR, Sizer P, Starch DW, Lockhart L, Slaunthereck J Effects of Gender on Knee Kinematic and 
Ground Reaction Force Characteristics During a Rapid Sprint and Cut Maneuver. Research Quarterly for 
Exercise & Sport, 2004;75:31-38.

Positives Using the Cyriax Release Test for Thoracic Outlet Syndrome in an Asymptomatic Population. 

of Positive Cervical Rotation-Lateral Flexion Tests for Elevated First Ribs in Asymptomatic Subjects 
and Correlations with Cervical Range of Motion Measurements. Journal of Manual & Manipulative 
Therapy 2002; 10(3):166-7. ABSTRACT

Coffey TG, James CR, Sizer PS, Williams JS Effects of Gender and Fatigue on Lower Extremity 

James CR, Sizer PS, Poklikuha G, Elliott L, Coffey T, Davis J Effects of Jumping Fatigue on GRF Impact 

Halverson L, Maas R Shoulder Joint Capsule Distention (Hydroplasty): A Case Series of Patients with 
“Frozen Shoulders” Treated in a Primary Care Office, Journal of Family Practice. January 2002; 51(1), 61- 
63. ABSTRACT

Journal of the American Board of Family Practice, 2002; 15(4):304-308. ABSTRACT

Clark R, Sizer P, Slaunthereck J Stress Fracture of the Ulna in a Male Competitive Polo Player. American 

Sizer P, Phelps V, Dedrick G, Matthijs O Differential Diagnosis and Management of Spinal Nerve 
RootRelated Pain. Pain Practice 2002; 2(2),98-121. ABSTRACT

ABSTRACT

36 (2), 170-173. ABSTRACT

ABSTRACT

Practice, 2001; 2:136-149. ABSTRACT

Sizer P, Phelps V, Brismée J Differential Diagnosis of Local Cervical Syndrome as Compared to 

Sizer P, Starch S, James R, Slaunthereck J Kinematic and Ground Reaction Force Comparison of Male 


Pain, 2000; 4:362-373. ABSTRACT

Therapy, 1998; 28: 88-96. ABSTRACT

Electronic Publications

Examination. MD Consult 2005; In press.

Sizer P, Phelps V, Hay A, Azevedo E Upper Cervical Disorders Part II: Differential Diagnosis and 
Management. MD Consult 2004
IAOM CERTIFICATION IN ORTHOPEDIC MEDICINE AND MANUAL THERAPY


The IAOM-US has created the Hand and Upper Extremity Specialty Track for certified hand therapists (CHTs), occupational therapists and physical therapists specializing in the upper extremity. Courses in this track are two-day intensive, and the IAOM-US is now happy to offer certification upon completion of all UE track courses.

Individuals certified in the Upper or Lower Spine, Upper or Lower Extremities, or UE Track, and obtaining their COMT (Certification in Orthopedic Manual Therapy) will be able to thoroughly diagnose and treat patients with orthopedic problems. Because of increased understanding of pathoanatomy, joint-specific biomechanics, and their inter-relationships, certified clinicians are able to make precise recommendations for conservative treatment and for individualized home programs. Although there can be no guarantee, certified clinicians (and their clinical sites) have reported increased treatment efficiency and decreased number of patient visits secondary to successful restoration of function.

I. IAOM-US COURSES LEADING TO CERTIFICATIONS IN ORTHOPEDIC MANUAL THERAPY

To become certified through the IAOM-US in Orthopedic Medicine and Manual Therapy an individual must meet the following requirements:

1. Upper Extremity Certification (3 Hybrid courses: Shoulder, Elbow, Wrist & Thumb)
2. Lower Extremity Certification (3 Hybrid courses: Hip, Knee, Ankle & Foot)
3. Complete Extremity Certification (6 Hybrid courses: Shoulder, Elbow, Wrist & Thumb, Hip, Knee, Ankle & Foot)
5. Lower Spine Certification (3 Hybrid courses: Acute Lumbar and Sacroiliac Joint, Recurrent Lumbar and Root Related Pain, Thoracic Spine & Ribs)

7. UE Track Certification I (3 two day courses: UE Hand, UE Wrist Part 1, UE Wrist Part II)

8. UE Track Certification II (3 two day courses: UE Elbow, UE Shoulder, UE TOS/CTJ)

Successful completion of certification for a minimum of three courses (67.5 contact hours) results in a "COMT" Certification. The Certification will become official within two months of the examination date. You will then be entitled to use the initials "COMT" following your name and credentials.

II. MODULAR ASSESSMENT
To ensure adequate learning of course-material, IAOM offers the participant modular-based competency assessments that are applicable to completed courses. The examinations are completed during an IAOMUS course-weekend with an approved instructor.

A. Content of the Modular Examinations
In undergoing the modular examinations, participants have the following choices:

1. Modular Examination for any 3 courses: Participants working toward certification of the Spine and the Extremities are eligible to sit for written & practical examinations for any combination of three Hybrid IAOM-US courses. After successfully completing the examinations for each module, participants will be officially notified by mail within 2 months of passing the module.

2. Modular Examination for Upper Extremity Track courses: Participants working toward certification for the UE track are eligible to sit for written & practical examinations after they have taken either of the two three-course sequences. After successfully completing the examinations for each module, participants will be officially notified by mail within 2 months of passing the module.

The following modular examinations are available:
1. Modular Examination Upper Extremity (Shoulder, Elbow, Wrist/Thumb)
2. Modular Examination Lower Extremity (Hip, Knee, Ankle/Foot)
3. Modular Examination Upper Spine (Upper Cervical, Lower Cervical, TOS/CTJ)
5. Modular Examination All Extremities
6. Modular Examination All Spine
7. Modular Examination UE I (UE Hand, UE Wrist Level I, UE Wrist Level II)
8. Modular Examination UE II (UE Elbow, UE Shoulder, UE TOS/CTJ)

B. Application for the Modular Examinations
Applications for any Modular Examination should be made to the IAOM-US office no later than 1 month prior to the requested date of testing.
Applications may be submitted by
1. Mail: IAOM-US, P.O. Box 65179, Tucson, AZ 85728
2. e-mail: info@iaom-us.com
3. Phone: 866-426-6101
(from outside the US, phone: 520-318-4266)
C. Fee for Applications for the Modular Examinations for Physical Therapists and Occupational Therapists

1. Modular Examination for 1 through 9 Above $450
2. Modular Examination for All Extremities $900
3. Modular Examination for All Spine $900
4. Modular Examination for All UE $900

The examination fee is due at the time of the examination request. In the event the individual cancels the test within 2 weeks of the scheduled date, IAOM-US will refund the individual for the examination fee minus a 15% administrative fee.

Colleagues failing one portion (written or practical) of the examination are allowed to re-take the failed portion within one-year of the date of their examination. If they schedule a re-take after one-year, they are required to re-take the entire examination (both written and practical). In the event of failure to pass a module, retake of the examination is ½ price of the modular original price (if modular exam is $200, retake of the full examination is $100; retaking the written examination only is $50 and the practical examination only is $50).

III. EXAMINATION PROCESS

The IAOM-US schedules each year a set of dates and locations in the United States for clinicians to take their examinations. Information about dates and testing sites are available at the IAOM-US Website. IAOM-US reserves the right to cancel any certification due to insufficient registrations. We will inform candidates of cancellation within 5 weeks of any scheduled certification. For more information, contact the IAOM-US at 1-866-426-6101.

To best prepare for the examination, we recommend you study the material in the course manuals provided at the courses. We also recommended that you purchase the DVDs (for OMT) as the practical examination comprises the material from the DVDs as well as the course manuals and textbooks. Written examinations are generally scheduled for the morning of the testing date. Colleagues registering to take the IAOM-US certification examination are required to take both the written and practical examination on the same day (or on 2 consecutive days in cases of an unusually large group taking the examination).

A. Examination of Physical Therapists and Occupational Therapists

The examinations for each module consist of two parts:

1. Written Examination
   - Scheduled for a maximum of 2 hours for 3 module examination or 3 hours for 6 module examination
   - Test taken on a scantron (provided); bring a #2 Pencil
   - Consists of multiple choice and true/false questions
   - Material for the examination consists of the IAOM-US course manuals and the course textbooks, and online course video modules.
   - Includes questions regarding:
     a) Pathoanatomy
     b) Surface anatomy
     c) Pathology
     d) Biomechanics, osteo- & arthrokinematics
     e) Differential diagnosis
     f) Manual Therapy
     g) Other treatment approaches

2. Practical Examination
   - Follows the written examination
   - Scheduled for 1 hour 30 minutes for each group of two (in case of groups of 3, time will be extended)
• Practical Exam will be videotaped
• Includes the following*:
  a) 1 basic clinical or local segmental exam  35%
  b) Surface anatomy locations (10% each)  20%
  c) 2 mobilization techniques (15% each)  30%
  d) 1 high velocity manipulative technique  15%

* The following format applies for modular examinations of 2 or 3 IAOM-US courses.
  Modular examinations for the 4 (Upper Quadrant) or 6 IAOM-US courses, often
  includes a greater number of techniques.

Passing Score
• Written Examination: 70%
• Practical Examination: 70%
• Overall score: 70%

*Note: The practical examination counts twice the written examination. For example, a grade of 70% on the
written examination and a grade of 80% for the practical exam results in an overall score of 77%, as
illustrated: 70 + (80 x 2) = 230/3 = 77%

IV. CERTIFICATION IN ORTHOPEDIC MANUAL THERAPY (COMT)

To obtain Certification in Orthopedic Manual Therapy, individuals are required to submit proof of:
• Current membership of the IAOM-US.
• PT, OT licensure in the state of practice.

Please note: To align IAOM-US with the American Physical Therapy Association and American
Academy of Orthopaedic Manual Physical Therapists stance regarding physical therapist assistants
performing joint mobilization/manipulation, effective January 1, 2006, IAOM-US no longer offers a
certification process for physical therapist assistants nor occupational therapist assistants.

Each school or academy of manual therapy has its OWN certification process for manual therapy. This
is the initial recognition of completing an education and passing a "certification" examination by that
particular organization, and it is termed COMT.

For many schools or academies of manual therapy, this certification process is a step toward even
greater acknowledgment after study and clinical contact, via the Fellowship program. Fellowship
programs are recognized by the APTA. The IAOM has a Fellowship program that has been
recognized by the APTA and successful completion of this program allows the individual to apply for
fellowship status with the AAOMPT. The IAOM certification process is also part of the Doctor of
Science program in physical therapy for Texas Tech University.

Currently, the AOTA does not have fellowship recognition, and Texas Tech does not have a doctoral
program in occupational therapy. The latter is in current stages of development.

The IAOM-US Certification in OMT is a career-defining achievement. Because this process can transform the
clinician from novice to musculoskeletal specialist, the ongoing learning that follows this achievement is
strongly encouraged and supported through various IAOM-US resources including membership, fellowship
and doctoral education.

Stay on the transformational journey! Witness the journey in the Connection. Study the content and gain the
skills through the courses. Be challenged in the Certification Exam. Become a Master in the Fellowship.
Become a Leader through Doctoral Education.
V. FELLOWSHIP PROGRAM


The mission statement for IAOM-US Fellowship Program is based on a commitment to excellence in clinical practice and professional development. In response, the IAOM-US Fellowship Program is committed to advancing physical therapy practitioners in evidence-based clinical diagnostics and orthopedic manual therapy.

Call the IAOM-US office or go to our website at http://www.iaom-us.com/ for more details.
IAOM-US Glossary

Signs & Symbols

GLOSSARY FOR TERMS USED IN THE IAOM ORTHOPEDIC MEDICINE AND MANUAL THERAPY COURSES

1. **Actual resting position**: with respect to the pathological condition of the intra- and extra-articular structures, the actual position where the capsule is most relaxed or the position were the least nociceptive afference occurs.

2. **Anatomical axis**: the anatomical axes lie in the line created when two anatomical planes bisect each other. Therefore, every axis lies in two planes.
   - Frontal axis: lies in the frontal and transverse planes (runs right-left)
   - Sagittal axis: lies in the sagittal and transverse planes (runs dorsal-ventral)
   - Vertical axis: lies in the sagittal and frontal planes (runs cranial-caudal)

3. **Anatomical osteokinematics**: active or passive rotations around a defined axis. The movements start from the zero position and occur in an anatomical plane. These anatomical bone movements (osteokinematics) are used in order to describe and measure motions of the joint.
   - Flexion-extension: movements in the sagittal plane around a frontal axis
   - Abduction-adduction: movements in the frontal plane around a sagittal axis
   - Internal-external rotation: movements in the transverse plane around a vertical axis

4. **Anatomical joint**: two bony joint partners with the joint capsule, ligaments and intra-articular structures

5. **Anatomical planes**: three traditional planes, perpendicular to each other, which divide the body. The planes are used to describe and measure anatomical bone movements.
   - Sagittal plane: divides the body into right and left halves. Planes that are parallel to the midline sagittal plane are called parasagittal planes.
   - Frontal planes: divide the body into anterior/ventral and posterior/dorsal parts
   - Transverse planes: divide the body into superior/cranial and inferior/caudal parts

6. **Arcuate swing**: a “curved” swing. The swing of a bone which occurs in more than one plane. The swing occurs with an accompanying spin.

7. **Arthritis**: an inflammation of the joint due to trauma, systemic causes, etc. Clinical examination will show a limitation of motion in the capsular pattern.

8. **Arthrokinematics**: describes the relationship between two articulation joint surfaces when the bones move. The four basic movements in arthrokinematics consist of:
   - rock (concave) or roll (convex)
   - glide (concave) or slide (convex)
   - spin
   - translation

9. **Arthrosis = Osteoarthrosis = Osteoarthritis**: the “degenerative” aging process of a joint. The clinical examination will show a limitation of motion in the capsular pattern.
10. **Basic clinical examination**: a series of tests that will give the evaluator the most information in the shortest period of time, enabling the evaluator to be able to determine the most likely lesion. Often one must add specific extra test(s) to determine the diagnosis.

11. **Capsular pattern**: a specific sequence of limitations of passive motions in a specific relation which is specific for each joint. It always indicates an arthritis or an arthrosis (osteoarthrosis / osteoarthritis).

12. **Cardinal swing**: a “hinge” type swing. The swing of a bone which occurs in one plane, without an accompanying spin. This is theoretical; it does not occur in the human body.

13. **Curved gliding mobilization**: performed as a dynamic mobilization in very curved congruent joints (such as the humero-ulnar joint and the hip) in which traction is applied in an equal amount as the gliding force.

14. **End-feel**: at the end of every passive movement (whether angular or translatory) one tests the quality of that movement by giving overpressure. The type of structures (and their integrity) restricting that motion determine the end-feel. One can differentiate between a physiological or “normal” end-feel and a pathological end-feel. Every joint has a characteristic end-feel for each motion depending on the structure(s) restricting that motion. In general there are three different qualities of end-feel: soft, firm, and hard. Due to pathology or changes in a collagenous structure, the end-feel can change.

15. **Glide**: between two surfaces, when a new point on one surface comes into contact with a new point on the other joint surface. Pure gliding occurs between CONGRUENT surfaces. There are two types of gliding: straight (no axis) and curved (has an axis).

16. **Hypermobility**: more than normal mobility (in comparison to the “normal side”)

17. **Hypomobility**: less than normal mobility (in comparison to the “normal side”)

18. **Instability**: (Functional instability) a hypermobility with pathology

19. **Joint play**: the quantity (amount) and the quality (end-feel) of movement that a joint capsule allows in translatory directions of traction and gliding.

20. **Joint specific examination**: a series of tests used to determine and/or evaluate a hypermobility or hypomobility in a joint. The tests consist of performing joint play of traction and gliding/sliding in which the quantity and quality (end-feel) of each direction is determined and always compared to the non-affected side. Occasionally the tests consist of angular movements in joints where translatory movements are impossible or too impractical to perform, such as in the patellofemoral joint and the subtalar joint.

21. **Kennedy’s Stages of Tendinitis**:
   - **STAGE I**: Pain after activity
   - **STAGE II**: Pain at the beginning and after activity
   - **STAGE III**: Pain at the beginning, during and after activity, but the performance is not affected
   - **STAGE IV**: Pain at the beginning, during and after activity and the performance is affected

22. **Maximal close-packed position**: Position of the joint in which:
   - joint surfaces have the most contact
   - joint capsule and ligaments are most taut
   - joint partners cannot be separated through traction and translatory gliding is minimal

23. **Neuromuscular Reeducation or Training**: (after a session of mobilization)
As a part of every joint specific mobilization session, proprioceptive training consists of moving the joint within the newly gained range of motion with respect to the osteokinematic and arthrokinematic behavior of the joint. Therapist performs the osteokinematic rotation and the arthrokinematic gliding/sliding. This is done in three parts: first passively, then active-assisted, then the patient is asked to perform an isometric contraction of the agonist at the end of the newly gained range of motion.

24. **Osteoarthritis**: see **ARTHROSIS**

25. **Osteokinematics**: describes movement of bone in space. The two basic movements are rotation and translation.

26. **Physiological joint**: anatomical joint with all of the surrounding structures to include innervation, blood supply, etc.

27. **Physiological movements**: movements in the joints during daily activities do not occur around the rigid anatomical axes. Movements occur simultaneously around many axes and similarly the movements take place in many planes (not only in one anatomical plane).

28. **Physiological osteokinematics**: a coordinate system for each joint specific to the position of the concavity in space. For example: an anatomical osteokinematic shoulder flexion is a physiological osteokinematic shoulder flexion, abduction and external rotation.

29. **Radicular pain**: projected pain originating from irritation of a nerve root.

30. **Referred pain**: pain felt in an area of the body different from the local area from which the pain originates. Except for the organs and dura mater:
   - the pain does not cross the midline
   - the deeper the lesion the further the pain radiates
   - the more severe the lesion the further the pain radiates
   - the more distal in the extremity the lesion lies, the less referred pain
   - pain can be felt in the whole dermatome or in part of the dermatome
   - the kind of structure determines the amount of referred pain e.g. skin has minimal referred pain whereas nerves give a large amount of referred pain
   - pain is usually referred distally from the affected structure and not proximally

31. **Resting position = maximal loose-packed position**:
   - capsule most relaxed and therefore has the most volume
   - joint surfaces have least contact with each other
   - joint play is the greatest in this position

33. **Roll**: the name for the arthrokinematic movement that occurs between two surfaces, when a new point on one surface comes into contact with a new point on the joint surface. Rolling occurs between two INCONGRUENT surfaces. The convex surface rolls, and the concave surface ‘rocks’. When the convex surface moves, the rolling and the gliding occur in opposite directions. When the concave joint partner moves, the rolling and the gliding occur in the same direction.

35. **Rotation**: all active and passive motions, which occur around one axis. There is always one point of the moving bone that does not move. The two basic osteokinematic rotations are **SPIN** and **SWING**.

36. **Slack**: the amount of movement that a joint capsule allows during a passive translatory movement. After that point the fibers of the capsule are stretched.

38. **Spin**: Osteokinematic spin: the rotation about the longitudinal axis of the bone  
Arthrokinematic spin: the rotation about one axis that is perpendicular to the contact point of the articulation (both perpendicular to the concavity and to the convexity)
39. **Swing**: all osteokinematic rotations outside of a spin. There are two kinds of swing: CARDINAL SWING and ARCUATE SWING.

40. **Traction**: distraction or separation of the two joint partners in the direction that is perpendicular to the treatment plane

41. **Translation**: between two surfaces, when all the points of one surface move in a straight line the same distance, at the same speed, and in the same direction:
   - the movement does not occur around an axis
   - can move perpendicular to the treatment plane = traction
   - can move parallel to the treatment plane = glide
   - are always passive movements; do not occur actively in a joint

42. **Transverse friction**: local massage technique transverse to the running of the fibers of the affected structure with local pain relief and transverse mobilization as the two main goals:
   - therapist’s finger and patient’s skin move as one over the affected structure
   - pressure is exerted to patient’s tolerance and can be increased after about 2 minutes when the local anesthetic effect has occurred. When a tendon sheath is being treated, the stretch is increased after approximately 2 minutes when the local anesthetic effect has occurred.
   - pressure is exerted only in one direction. This prevents a local ischemia

43. **Treatment plane**: the plane perpendicular to the line connecting the actual contact point and the center of the curved surface of the joint or plane formed by the concavity

44. **Visual Analog Scale**: Patient rating of pain and/or symptoms on a scale of 0 to 100 with 0 being no pain/symptoms and 100 being the most (or worst) pain/symptoms imaginable. (Patient is given a 10cm long line without markings on which to indicate pain/symptoms. Patient does not have access to ratings from previous days.) Pain is rated daily and at approximately the same time each day. Therapist measures and records the daily markings on a graph. This is an objective way to rate pain/symptoms and the effects of treatment and/or daily activities.

45. **Zero position** = null position = neutral position: internationally recognized positions of each joint which are used as starting positions from which to measure bone movements
Signs & Symbols Used in IAOM Orthopedic Medicine And Manual Therapy Courses

+/− = approximately

RPT = resting position traction (traction from the maximal loose packed position)

PPT = prepositioned traction
  • P₁PT = prepositioned in one dimension
  • P₂PT = prepositioned in two dimensions
  • P₃PT = prepositioned in three dimensions

RPG = resting position gliding

PPG = prepositioned gliding
  • P₁PG = prepositioned in one dimension
  • P₂PG = prepositioned in two dimensions
  • P₃PG = prepositioned in three dimensions

= pain

= hypomobility

= hypermobility

± = very minimal  + = minimal  ++ = moderate  +++ = severe

E = END-FEEL:

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<th>SOFT</th>
<th>FIRM</th>
<th>HARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>33</td>
<td>66</td>
</tr>
</tbody>
</table>

Documented as follows: E healthy side/E affected side.
  e.g. elbow extension: E 80/50, elbow flexion: E 30/60
□ = resisted

A = active

P = passive

Extension: ↓

Flexion: ↑

Sidebending Left and Right: ← →

Axial Rotation Right:

Axial Rotation Left:

Limitation of Range of Motion:

Increase in Range of Motion:
Differential Diagnosis and Manual Therapy of the

Thoracic Spine & Ribs

Pathoanatomy

Thoracic Spine

Picture 1: Slide 1

Introduction

History

Picture 2: Slide 2
### PubMed Search in past 40 yrs

<table>
<thead>
<tr>
<th>Spine Type</th>
<th>Results</th>
</tr>
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<tr>
<td>Cervical spine</td>
<td>36,668</td>
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<tr>
<td>Lumbar spine</td>
<td>50,984</td>
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<td>Thoracic spine</td>
<td>22,337</td>
</tr>
<tr>
<td>Cervicothoracic spine</td>
<td>596</td>
</tr>
</tbody>
</table>

**Why? So little surgery...**

---

**Picture 3: Slide3**

---

### Introduction

- **Challenge to Clinicians**
- **False (-) Imaging**
- **Eg’s...**
  - IDD = internal disc disruption
  - Costotransverse joint
  - Zygapophyseal Joint (ZAJ)
    - Synovitis
    - Chondropathy

---

**Picture 4: Slide4**
Introduction

Diagnosis Based on Knowledge

Pathoanatomy
Biomechanics
Neurophysiology

Introduction: Diagnosis

Unique Features associated with Thoracic Spine:

- Ribcage
- Rib Joints: CVJ & CTJ
- Connection with the sternum

**Introduction: Thoracic Region**

- **Functions:**
  - Supportive
  - Protective
  - Transitional
  - NOT made for movement!


Picture 7: Slide7

**Introduction: Thoracic Spine**

- **Designed for rigidity**
  - Vital for general erect bipedal support
  - Protection of the cord

- **Facilitates the mechanical activities of lungs and rib cage**

- **Transitional region** between two mobile regions: cervical (rotation) and lumbar (flex-ext)


Picture 8: Slide8
**Introduction: Thoracic Spine**

- **Transitional region** between two mobile regions: cervical (rotation) and lumbar (flex-ext)

- **Greatest number** of vertebrae
- **Greatest variation** of vertebrae
- **Least outspoken coupling pattern**


**Introduction: Cranial Junction**

- C-spine -- T-spine
- **T1 - T4**
  - More axial rotation

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"TRUE" Thoracic Spine

T4

T10

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Picture 11: Slide11

Introduction: Caudal Junction

T-spine -- L-spine
T11 – T12
- More flexion-rotation

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Picture 12: Slide12
Rib Cage

- **Functions:**
  - Protective barrier for vital organs: heart and lungs.
  - Stiffens the thoracic spine, which in turn increases its inertia.
    - Leading to increased stiffness and strength in all motions
  - Strengthens the thoracic spine and increases energy absorption during trauma.

---

**Introduction: Vertical and Horizontal Chains**

- Spinal column
- Ribs
- Extremities
**Introduction: Loads and Forces**

"Thoracolumbar spine: is the principal load-bearing structure of body. Subject to a wide variety of forces ... Understanding these forces & effects on spine is crucial for safe & efficacious treatment of spinal deformities..."


---

**Introduction: Oncology**

- Incidence of bone metastases in patients with cancer of all types is approximately 70%
- After lung and liver, skeletal system 3rd most frequent site
  - vertebral column most commonly affected region

Introduction: Methods of Classification of the Thoracic Spine

- Anatomical
- Morphological
- Ribs: Connections
- Ribs: Mechanics
- Kinematic Behaviors

Introduction: Classification

- Anatomical
- Morphological
- Ribs: Connections
- Ribs: Mechanics
- Kinematic Behaviors

Picture 17: Slide17

Picture 18: Slide18
Classification

Anatomical
Morphological
Rib: Connections
Rib: Mechanics
Kinematic Behaviors

T1 - T4
- Like C-Spine
- Narrowing of canal

T4 - T10
- True T-Spine
- Narrowed canal
- Critical Vascular

T11 - T12
- Like L-Spine
- Widening canal


Picture 19: Slide19

Classification: Morphological Relation of Blood Supply and Space

Relative Blood Supply
Maximal
T4
T9
Minimal
Moderate

Relative AP Canal Diameter
Maximal
T4
Minimal
T9

T4-T9: Critical Zone


Picture 20: Slide20
**Classification: Morphological**

- Maintained its kyphotic curve from embryology
- Greatest number of vertebrae
- Large variation in form
  - cranial to caudal

---

**Classification**

**Anatomical**

**Ribs: Connections**

**Ribs: Mechanics**

**Kinematic Behaviors**

**Ribs 1-7**
- Direct sternal
- ↑ d F / E stiffness
- No Δ in rotation

**Ribs 8-10**
- Indirect sternal
- ↑ d rotation stiffness
- ↑ d F / E

**Ribs 11-12**
- No sternal
Classification

Ribs 1-6
- Move more in A-P
Ribs 7-10
- Move more in lateral

Rib Elasticity
Ribs 1-4
- Stiff, strong, rigid
- Relative immobility
Ribs 5-12
- Greater elasticity
- Fracture potential

Anatomical

Morphological

Ribs: Connections

Ribs: Mechanics

Kinematic Behaviors

---

Classification

T1-2 to T3-4
- Like C-spine; ↑ rotation
- Ipsilateral coupling

T4-5 to T7-8
- Silent zone
- Mobility dependent; tendency for
  - Men: Ipsilateral in extension
  - Women: Contra in extension

T9 - T12
- Like L-spine; ↑ F/E
- Contra coupling in extension

---


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Classification

Transition Zones
- C-spine → T3-4
- UE → T5-6
- LE → T7-8

Greatest Rotation
- During gait → T6-T8
- 2° to UE & LE

Anatomical
Morphological
Ribs: Connections
Ribs: Mechanics
Kinematic Behaviors

**Bony Anatomy: Transverse Plane**

- **Vertebral Body**
  - Not kidney shaped as in lumbar spine
  - A-P diameter ≥ transverse diameter
  - Load carried more ventrally on vertebral body, due to kyphosis
  - Spinal canal is small and round due to short, thick pedicles


**NOTE:**

**Aorta Lies Along Left Side of Tspine**

- **Thoracic Spine**
  - Has significantly more osteophytes on right side
  - Relation to idiopathic scoliosis?

**Bony Anatomy: Transverse Plane**

- **Endplate** is thinnest
- **Zygapophyseal joints**
  - 20° inclined in transverse plane.
  - Provide little resistance to rotation (compared to lumbar spine)

---

**Bony Anatomy: Transverse Plane**

**Transverse processes**
- T1-T7: Long, frontal
- T8 down: Short, oblique dorsally

**Consequences:**
- T-processes easier to palpate compared to lumbar spine
- Rib movement:
  - During inhalation, ribs 1-7 move more anterior, increasing AP diameter of the thorax
  - Ribs 8-12 move more laterally
  - (Except in deep inhalation, ribs 1&2 hardly move)
Bony Anatomy: Frontal Plane

Spinous Processes
- Asymmetry due to muscle pull
  - Up to 1cm out of alignment
- Length stays same, angulation differs
- Site for clay-shoveler’s fracture (C7)
  - Stable fracture thru spinous process
  - Mechanism of injury: muscle pull through processes


Picture 31: Slide31

Bony Anatomy: Frontal Plane

Spinous Processes

Finger Rule:
(Surface anatomy)
Length greatest @ T5-T8
Variability especially T11-12


Picture 32: Slide32
**Bony Anatomy: Dorsal Plane**

**T12 only**

- Mamillary
- Insertion multifidus
- Accessory Process: Insertion rotatores

**Bony Anatomy: Sagittal Plane**

- **Lamina**
  - Like shingles over each other to create bony posterior wall
  - "Contre coup" mechanism
    - When disc protrudes dorsally there is no chance for other structures to move out of the way
    - A very small protrusion of the disc can cause immediate dural irritation

Picture 33: Slide33

Picture 34: Slide34
**Bony Anatomy: Sagittal Plane**

- **Body**
  - Wedge shaped
  - \(3.8^\circ \times 12 = 45^\circ\)

- **Pedicle**
  - Located cranial
  - Short & thick

---

**Spinous Processes**

- About equal in length
  - 5cm to 6 cm
  - Obliquity is unequal
    - T8 = most oblique
    - T11 = most dorsal orientation.
  - Largest difference in level between tip of spinous process and vertebral body is in mid thoracic spine

---

Picture 35: Slide35

Picture 36: Slide36
**Bony Anatomy: Sagittal Plane**

- **Intervertebral foramen:** lies very high in relation to the disc level.
- Costal facets located at sides of vertebral body for Costovertebral Joints.

---

**Bony Anatomy: Sagittal Plane**

- **Zygapophyseal joints:** oriented 60° inclined in parasagittal plane in relation to the endplate.
- Plays an important role in stabilization of thoracic spine during flexion loading.

---

Zygapophyseal Joint Orientation

- $20^\circ$ inclined in the transverse plane
- $50^\circ$ to $60^\circ$ inclined in the sagittal plane


Bony Anatomy: Sagittal Plane

- Para-articular bony prominence, spur or process:
  - Mostly seen between T6 & T10,
  - Most outspoken at T9 & T10
  - Possible cause for irritation of spinal nerve and paravertebral plexus
  - Not present elsewhere in the spine

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CostoVertebral Articular Facets

- Rib 2 to Rib 8 (9):
  - Connected to 2 vertebrae
    - Cranial and corresponding
- Rib 1, Rib (9) 10-12:
  - Connected to 1 vertebra
  - Corresponding vertebra

Anatomy
Capsuloligamentous Considerations
**Capsuloligamentous**

**Intervertebral disc**
- Symmetrical load
- Uniform shape

---

**Capsuloligamentous: IV Disc**

- Most **Narrow**
- Varies; 1:5 - 1:7
- More annulus material in dorsal part
  - Type 2 collagen dorsal (tolerates stretch)
  - Type 2 collagen ventral (tolerates compression)
Capsuloligamentous: IV Disc

Regional Disc-Ratios

- “Tied” to the ribs
- Natural abutment
- ↑’d stability
- Thin end-plate

Picture 45: Slide45

Capsuloligamentous: IV Disc

Cartilaginous End-Plate

- Schmorl’s Nodes (SN)
- Discal Prolapse through the CEP (which is thinnest here)

Picture 46: Slide46


**Intervertebral Disc: Mechanics**

- Avg. wedge shape of vertebral body of 3.8-3.9° for total 45.6°
- Resulting Kyphosis
- ↓'d ZAJ load
- ↑'d Disc pathology
- Fractures
- Pathology in children
  - Tends to occur at growth centers

**Intervertebral Disc**

**IV disc ↑'s segmental stiffness**


Intervertebral Disc

Discectomy (in adult cadavers) produced:

- Small increase in flexion
- Large increase in extension
- TAKE HOME MESSAGE: Posterior 1/2 of disc appears to be influential for controlling extension


Picture 49: Slide49

Intervertebral Disc

Discectomy

- Rotations after discectomy were approximately 12° greater than the rotations of the intact spines in all models, with 70% of the disc resection on average
- Large increase in extension

Wall EJ et al. Endoscopic discectomy increases thoracic spine flexibility as effectively as open discectomy. Spine 1998

Picture 50: Slide50
Intervertebral Disc

Thoracic Microdiscectomy

- Flexibility increased slightly during lateral bending and flexion
- The neutral zone, elastic zone, and range of motion increased significantly in all directions


Picture 51: Slide51

Intervertebral Disc

- Primarily Controls
  - Rotation
  - Extension
- Minor control
  - Flexion
  - Sidebending
**Intervertebral Disc**

“Although **herniation** was said to be unusual and difficult to diagnose in the past; entity presenting more frequently

- increased clinical awareness
- better imaging techniques.”
- **1% vs. 11%**

---


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**Picture 53: Slide53**

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**Intervertebral Disc**

**Other Studies**

- Disc thickest in lower thoracic region,
- Less support of stiff ribs, and more load:
  - Higher incidence of disc lesions causing spinal or radicular involvement.
  - Approximately 75% occur below T8,
  - With 28% at T11-T12.

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**Picture 54: Slide54**
**Intervertebral Disc: Innervation**

**Outer Anulus:**
- Poly-Segmental Innervation
- Diffuse Pain

**Inner Anulus:**
- Mono-Segmental Innervation
- Local Pain

Groen et al (1990);

**NOTE: IV Disc Innervation in Lumbar Spine...**

*Convergence with Somatic Afferents*

- Pain signals enter @ T-spine
- ↑’d Visceral Afferent Activation
- Irritation of Anterior Anulus (Through Ventral Fissures; Nakamura)
- Referred Pain to Visceral Reference Region

**Take Home Message:** lower thoracic management (soft tissue, joint mobs, e-stim, etc...) is sometimes indicated for patients with lumbar spine conditions to modulate the symptoms
**Intervertebral Disc: Symptomatology**

- In patients with vague thoracic, abdominal, organic pain
- Could correlate fissure on discogram with location of pain
  - Ventral – pain in lungs, heart, stomach
  - Lateral – diffuse lateral trunk (flank) pain
  - Posterior – local thoracic pain


**Picture 57: Slide57**

**Intervertebral Disc: Symptomatology**

- Seldom radicular lesions
  - Narrow disc
  - Ribs
  - High foramen
- Often: dura involved
  - Small canal
  - Contra coup

**Picture 58: Slide58**
**Intervertebral Disc: Symptomatology**

- Clinical presentation of **thoracic disc disease** (degeneration with/without herniation)
- Highly variable
- Often mimic visceral conditions, as well as causing musculoskeletal and/or back pain.


---

**Intervertebral Disc: Degeneration**

**Thoracic Spine**

- **Endplate fracture**, ventral >> dorsal
- Mechanical, Chemical
- Internal disc disruption, annulus fissure
- "Isolated disc resorption," spondylosis
- Disc: low water content, less turgescence.
- Protrusions. Less prolapses
- Decreased disc height (more obvious ventrally - kyphosis ↑’s)
  - Rarely: Instability
  - Less resorption (less narrowing), Other features of spondylosis

---

Picture 59: Slide59

Picture 60: Slide60
Peripheral Sensitization

Auto-immune Response
- Serotonin
- Histamine
- Bradykinin
- Phospholipase A2 (PLA2)
- Prostaglandins
- Leukotrienes

Collagenase Release

Silent Nociceptor Activation

Franson RC, Saal JC, Saal JA. Human disc phospholipase A2 is inflammatory. Spine, 1992; 17 (suppl): 129-132

Picture 61: Slide61

Peripheral Sensitization

Neurogenic Inflammatory Response
- Vasodilation
- Auto-immune Response
- d Threshold
- Peripheral Sensitization
- d Responsiveness
- in Receptor Field
- Pain, even during ordinary movement

Franson RC, Saal JC, Saal JA. Human disc phospholipase A2 is inflammatory. Spine, 1992; 17 (suppl): 129-132

Picture 62: Slide62
Sensitization

Medley of **Neurophysiological Responses**
(Woolf, 1999)
- Decreased membrane thresholds
- Increased responsiveness to afferent inputs
- Induced protein synthesis, leading to nerve generation
- Prolonged after-discharges
- Spontaneous neuron firing
- Expansion of receptor fields
- Reduction of inhibitory influences

---

Capsuloligamentous

- **PLL (more developed)**
  - Attached to disc, separate from body
- **ALL (less developed)**
  - Thicker & narrower
- **Flaval ligament**
  - ↓’d elasticity
Capsuloligamentous

Predisposition for Ossification

PLL


Flaval ligament


Capsuloligamentous: PLL & Flaval Ligament

Predisposition for Ossification: Signs & Symptoms

- Middle and lower back pain
- Difficulty with balance
- Progressive gait disturbance
- Onset of bladder retention
- MRI & CT sensitive: bony mass, edema & spinal cord compression
- Rx: A decompressive laminectomy
ZAJ Capsule

- Thin
- No menisci
- Very voluminous
- Mechanoreceptors
- Lower density of nociceptors


Picture 67: Slide67

ZAJ Capsule

- Innervated by medial branch of dorsal ramus
  - Supplied by axons from 1 to 2 adjacent root levels above, the same level, & 1 to 2 levels below
- Dreyfuss distended ZAJ capsules with IAJ injections
  - Symptoms remained in local paraspinal region extending 2 spinal levels above & below injected segment


Picture 68: Slide68
Muscles: Region of Overlap

- Intercostal muscles

Consideration:
- In Women
  - Larger # Type 1 fibers (Thorstensson ’87)
  - Size of fiber types very different: type 1 being much larger.
    - Type 2 atrophy may not be pathological


Picture 71: Slide71

Muscles: Insertions

- Spinous processes can be asymmetrical
- As much as 1 cm “out of line”

- Bogduk

Picture 72: Slide72
Muscles: Referred Pain from Viscera

High Incidence

Referred pain: Pain perceived in an area other than that which the noxious stimulus takes place

Somatic System

- Distal migration of dermatomes
- Discrepancy between motion segments and neurological levels

Somatic System

- T1-T6: 2 segment difference
- T7-10: 3 segment difference

So, Disc Prolapse impinging on the cord will exhibit signs from caudal motor segments...
Ventral Rami

- 12 pair
- Intercostal nerve innervates
  - Pleura
  - CT & CV joints
  - Intercostal muscles
  - Skin at ventral trunk
  - From T6 down: abdominal muscles

**Slide 77**

---

Ventral Rami:
“Slipped Rib Tip Syndrome”

**NOTE:**
- Subluxation of interchondral joints between the lower costal cartilages may trap intercostal nerves, causing referred abdominal pain.

**Slide 78**
Ventral Rami

- T1 sends axons to brachial plexus
- T2 to T4 send axons to nerves running to the arms
  - Posterior cutaneous nerve of the arm = radial nerve
  - Medial cutaneous nerves of the arm and forearm = median nerve = the intercostobrachial nerves
- T4 Syndrome

http://www.google.com/imgres?hl=en&sa=X&biw=866&bih=495&tbm=isch&prmd=imvns&pwt=hp1F2Phba-lCjH/HV6AQtNc&imgurl=http://quizlet.com/4588295/upper-extremity-1-vasculature-flash-cards/docs/meowabv7v1/229KXXMh&usg=__ibqc5yAfHwQyJI8wGw_lQwZ3qQkQVLE-Yh4Etee&oq=AX1&zoom=1&actv=chbTpsr=1458lycpv474ldum8639&source=1733&show=192&com=135&yr=105&sig=100574362338198717890&page=1&tn=137&m=125&ndsp=54&ved=1t:429,r:108

Picture 79: Slide79

Ventral Rami

- **T4 Syndrome**
  - Pain in Axilla
  - Parasthesia in T1, T2 dermatomes of UE
  - H/A when sympathetic system is ↑dB

http://www.google.com/imgres?hl=en&sa=X&biw=866&bih=495&tbm=isch&prmd=imvns&pwt=hp1F2Phba-lCjH/HV6AQtNc&imgurl=http://quizlet.com/4588295/upper-extremity-1-vasculature-flash-cards/docs/meowabv7v1/229KXXMh&usg=__ibqc5yAfHwQyJI8wGw_lQwZ3qQkQVLE-Yh4Etee&oq=AX1&zoom=1&actv=chbTpsr=1458lycpv474ldum8639&source=1733&show=192&com=135&yr=105&sig=100574362338198717890&page=1&tn=137&m=125&ndsp=54&ved=1t:429,r:108

Picture 80: Slide80
Ventral Rami

- T4-6 anterior chest
- T6-12 abdominal wall: Thus problems produce abdominal pain

Dorsal Rami

- Innervate
  - CV joints
  - Lateral ZAJ
  - Sacrospinal muscles
  - Skin at dorsal trunk
    - medial branch innervates locally
Doral Rami: Lateral Branch

Courses caudal then over to posterior costal angle


Azawa Y. The courses and the segmental origins of the cutaneous branches of the thoracic dural rami. Kalbogaku Zasshi; 1966;71:195-210

Picture 83: Slide83

Recurrent or Sinuvertebral Nerve

Ascending: PLL
V-Body
IV Disc

Dural Branch: Vent & Lat. Dura

Descending: Vasc. Supply
IV Disc
V-Body
PLL

Bogduk et al (1997)

Picture 84: Slide84
Autonomic Nervous System: The Sympathetic Trunk

- Spinal Cord (cross section)
- Dorsal root ganglia
- Spinal nerve
- Dorsal rami
- Ventral rami
- Communicating rami
- Sympathetic ganglia

Picture 85: Slide85

Autonomic Nervous System

- The afferent component of the autonomic system is identical to the afferent component of somatic nerves
- Once the afferent fibers gain entrance to the spinal cord or brain, they travel alongside, or mixed with, the somatic afferent fibers

Picture 86: Slide86
Visceral Afference

- C8 - T4: Heart
- C8 - T4: Pericardium
- T2 - T5: Lungs
- T6 - T8: Stomach
- T7 - T8: Liver
- T8 - L1: Spleen, Pancreas
- T10 - L1: Duodenum
- T11 - L1: Colon
- T11 - L1: Kidneys

Autonomic Nervous System: Sympathetic Efference

Intermediate Horn → Ventral Ramus → White Ramus → Traverse → Synapse (ganglion) → Gray Ramus → Peripheral nerve
**Sympathetic Efference, Influence On:**

- **Somatic System**
  - Vasoconstrictor fibers to blood vessels
  - Secreto-motor to sweat glands and
  - Motor to the erectores pilorum

- **Visceral System**
  - General vasoconstriction
  - Bronchial and bronchiolar dilatation
  - Glandular secretion
  - Pupillary dilation
  - Inhibition of alimentary contraction

---

**Sympathetic Efference**

- **C8 - T4**: Head, Cervical spine
- **T4 - T8**: Upper extremities
- **T1 - T5**: Heart
- **T2 - T4**: Lungs
- **T6 - T10**: Stomach
- **T7 - T9**: Liver
- **T6 - T10**: Spleen
- **T9 - T10**: Duodenum
- **T10 - L1**: Kidneys
- **T11 - L2**: Lumbar spine, Lower extremities, Colon

**Take Home Message:**

*All sympathetic preganglionic efferent fibers emerge through thoracic & upper lumbar spinal nerves as a thoracolumbar outflow. Increased sympathetic outflow can occur in chronic T/Spine conditions.*
Somatic and Autonomic Neurons

Picture 91: Slide91

Thoracic Spine: a Neurological Intersection

Picture 92: Slide92
For Instance...

**Angina Pectoris**
- Sternum
- Inner side of arm
- Face

**The REAL Question:**
- Why does this happen?
- More neuro-physiology


**Referred Pain**

Origin of pain that is referred to muscle or other somatic tissue areas:

**Visceral:** More frequent. Why? It’s the rule for visceral nociception

**Somatic:** From other muscles or joint structures

**Central Sensitization:** Clinical

Referred pain to muscle is frequently **hyperalgesic** in nature

Clinical conditions that result from central sensitization:

- Hyperpathia
- Allodynia
- **Hyperalgesia**
- Neuropathic Pain


---

**Chronic Pain:** Hyperalgesia

**Etiologies**

*Primary hyperalgesia:*

- Nociceptor (Peripheral) Sensitization
- Reduced Thresholds of Nociceptors

*Secondary hyperalgesia:*

- Central Sensitization
- Loss of Central Inhibition

Peripheral Sensitization

Increased **sensitivity** to painful events **long outlasts** the acute painful event

Typically associated with **algogenic** consequences

- Serotonin
- Histamine
- Bradykinin
- Prostaglandins,
- Leukotrienes
- Etc…

Central Sensitization

Increased **sensitivity** to painful events **long outlasts** the acute painful event

Typically associated with **algogenic** consequences

- Glutamate
- Substance P
- Nitrous Oxide
- Etc…
Visceral Pain

Referred Pain to Muscle from Visceral Structures
Follows True Visceral Pain Characteristics

True Visceral Pain:
- Vague, diffuse, poorly defined midline pain
- Marked neurovegetative signs (pallor, sweating, nausea, changes in blood pressure/HR, gastrointestinal disturbances, fever)
- Emotional reactions (anxiety, anguish)


Picture 99: Slide99

Visceral Pain: Result

Secondary hyperalgesia develops in the...

- Skin
- Subcutaneous
- Underlying Muscle

Picture 100: Slide100
Visceral Pain: Result

Transferred to the body wall (somatic): Area is dependent on:
- Organ involved
- Level of innervation

<table>
<thead>
<tr>
<th>Organs</th>
<th>Spinal Cord Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart</td>
<td>C8 - T8</td>
</tr>
<tr>
<td>Lungs</td>
<td>T3 - T10</td>
</tr>
<tr>
<td>Stomach</td>
<td>T5 - T9</td>
</tr>
<tr>
<td>Spleen</td>
<td>T6 - T10</td>
</tr>
<tr>
<td>Caecum &amp; Duodenum</td>
<td>T6 - T10</td>
</tr>
<tr>
<td>Pancreas</td>
<td>T7 - T9</td>
</tr>
<tr>
<td>Liver &amp; Gall Bladder</td>
<td>T7 - T10</td>
</tr>
<tr>
<td>Appendix</td>
<td>T9 - T11</td>
</tr>
<tr>
<td>Kidney</td>
<td>T9 - L2</td>
</tr>
</tbody>
</table>

Example: Myocardial Infarct

**Immediate**: lower sternal and epigastric pain

**Vegetative**: pallor, sweat, nausea/vomiting

**Referred**: (L) pectoralis, (L) upper extremity

**Tenderness**: pectoralis region

**Hyperalgesia**: ↑’ d effort...↑’ d muscle pain in pec’ s & lattis

Example: Kidney Stone

**Immediate**: deep posterior peritoneal

**Vegetative**: pallor, sweat, nausea/vomiting

**Referred**: lumbar, ipsilateral thigh / groin

**Tenderness**: lumbar and iliac region


Other Associated Signs

**Cutaneous hyperalgesia**

**Tenderness**

**Reflex muscle spasm**

**Sympathetic hyperactivity**

When?

At Rest
With activity / exercise
Many times no change with activity


Why?

Muscle contractions (con vs. ecc)
Trauma
Inflammation
Neoplasm
Visceral affliction
Metabolic disorder

**Viscerosomatic Convergence**

**Viscerosomatic Convergence in the CNS**

Lamina V

Higher center *Mis-interpretation*

**Lamina I**
- Unimodal
- Localized, defined pain pattern

**Lamina V**
- Polymodal
- Vague, non-focal, referred pain pattern


Picture 107: Slide107

---

**Viscerosomatic Convergence**

**Why Hyperalgesia?**

Central sensitization in the dorsal horn

\[ \uparrow \] d excitability in the dorsal horn neurons

\[ \downarrow \] d post-synaptic membrane thresholds

Triggered by \[ \uparrow \] d ‘flood’ of visceral afferent information

Picture 108: Slide108
Somatosomatic Referred Pain

Referred Muscle Pain from Somatic Structures
   Deep
   Vague
   Non-radicular

Sources:
   Muscle
   Joint Structures
   Disc


---

Somatosomatic Referred Pain

Referred Pain from Joints
   Typical example: ZAJ Arthritis
      • Localized, deep aching pain
      • Referred to thoracic paraspinals
   Somato-visceral referral
Somatosomatic Referred Pain

Referred Pain
Surrounding muscles ache and are tender
↑'d chemoreceptor activity, due to release of algogenic substances through the synovia of affected ZAJ
↓'d pain thresholds in surrounding tissue, especially in paraspinals


Picture 111: Slide111

Somatosomatic Convergence

Somatosomatic Convergence in the CNS
Lamina V
Higher center Mis-interpretation.

Lamina I
Unimodal
Localized, defined pain pattern

Lamina V
Polymodal
Vague, non-focal, referred pain pattern


Picture 112: Slide112
Somaticsomatic Convergence: Pathology?

Triggered by ↑ d ‘flood’ of somatic afferent information


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Questions?
Thoracic Spine
Biomechanics

Kinematics

Mobility
- influenced by ribs

Coupling

Location of the Axes

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Picture 116: Slide1

Picture 117: Slide2
Thoracic Segmental Mobility

- **Translation**: Increased

- **Axial Rotation**: Increased

Molnar, 2006; Qui, 2007

---

IAR for Axial Rotation

- In Posterior Disc
- Anterior to the ZAJ
- In the center of rot path

IAR for Flexion / Extension

**Flex:** Below disc

**Ext:** Above disc

↑’d Translation

**Spondylosis →**

ZAJ arthropathy

---

IAR for Sidebending

**(L) SB:** (R) side lower V-body

**(R) SB:** (L) side lower V-body
Influence of Ribs on Kinematics

**F / E:** Constraint

**SB:** Constraint

**Rot:** Not as significant
Thoracic Kinematics

**Least Mobility** in Entire Spine
- Visceral functions most important

---

Thoracic Kinematics

**Factors** that limit motion:
- Facet Position
- Flaval Ligament
- Narrow Disc
- Ribs-Sternum
- Spinous Process
- Muscle

**Result:** ↑ d Stiffness
Thoracic Kinematics

Regional Mobility
- Sidebending
- Axial rotation
- Flex / Extension

Thoracic Spine: Flexion Limits

Factors that limit flexion:
- Disc (Panjabi, 76)
- Ligaments & Muscles
- Ribs & Sternum

Result: ↑’d Stiffness

**Thoracic Spine: Extension Limits**

**Factors** that limit extension:
- Spinous Processes
- Articular Processes
- Disc (Panjabi, 76)

**Result:**  \( \uparrow \) d Stiffness


**Thoracic Spine: Rotation Limits**

**Factors** that limit rotation:
- Disc (Panjabi, 76)
- Provocative with Disc Lesion


Picture 128: Slide13

Picture 129: Slide14
**Thoracic Spine: Sidebending Limits**

**Flexion moment (L)**

**Extension moment (R)**

**Factors** that limit SB:
- Ribs

**Result:** $\uparrow$ d Stiffness

---

**Thoracic Kinematics**

**Regional Mobility**

---

Picture 130: Slide15

Picture 131: Slide16
## Thoracic Kinematics: Structures Restricting Angular (Rotation) & Translatory Motions

<table>
<thead>
<tr>
<th></th>
<th>Rotation</th>
<th>Translation</th>
<th>Tertiary Restrictors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flexion</strong></td>
<td>Disc</td>
<td><strong>ZAJ facets</strong></td>
<td>Upper Ribs</td>
</tr>
<tr>
<td><strong>Extension</strong></td>
<td><strong>ZAJ facets</strong></td>
<td>Disc</td>
<td>Lower Ribs</td>
</tr>
<tr>
<td><strong>Spinous Processes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sidebending</strong></td>
<td>Ribs</td>
<td>Disc</td>
<td>ZAJ facets</td>
</tr>
<tr>
<td><strong>Axial Rotation</strong></td>
<td>Disc</td>
<td><strong>ZAJ capsule</strong></td>
<td>Ribs</td>
</tr>
</tbody>
</table>

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*www.iom.edu*

### Thoracic Kinematics: ROM

- ↑ ROM from 15 to 24 years
- Extension in females > males (*due to difference in size of spinous processes?*)
- Flexion/Extension ROM greatest at T9-T12
Thoracic Kinematics: Coupling

- posterior versus other levels (Dvorak & Jirout)
- T1-4: Rot / SB ipsilateral (in flexion & extension)
- T5-T8: Silent Zone
- T9-12: Rot / SB contralateral in extension
- Rot / SB ipsilateral in flexion


Picture 134: Slide19

Thoracic Spine: Other

- Maximal Close Packed Position, MCPP
  - Extension (Andriachi)

- Scoliosis (R) convex with (R) handed
  - Why? (R) UE movement: (L) rotation of vertebral body

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www.iaom.com

Picture 135: Slide20
Questions?
Differential Diagnosis and Manual Therapy of the Thoracic Spine & Ribs

Surface Anatomy of the Thoracic Spine & Ribs

Dorsal Aspect

Spinous Processes:

- **C6** = level of cricoid cartilage ventrally, and dorsally, it is the most caudal SP to translate ventral during extension.
- **C7** = last vertebra to show a large rotation coupling during SB.
- **T1** = most cranial SP to translate dorsal with gentle pressure exerted dorsally on the manubrium of the sternum.

Picture 137: Slide1

Picture 138: Slide2
**Dorsal Aspect**

**Spinous Process T3:** Usually at spine of scapulae

**Spinous Process T7 & Vertebral body T8:** Inferior angle of scapulae

---

**Spinous Processes, Transverse Processes and Ribs Location**

---

Picture 139: Slide3

Picture 140: Slide4
**Transverse Process: “Finger Rule”**

- T1-T2 = one
- T3-T4 = two
- T5-T8 = three
- T9-T10 = two
- T11-T12 = one

Confirm the location by palpating the corresponding Rib

**12th and 11th Ribs**

12th: Just cranial to the iliac crest. The tip is usually palpable dorsal to the frontal plane of the body. It can be followed dorsally and cranially (area between spinous processes of T11 and T12)

11th: Just cranial to 12th rib. The tip is usually palpable ventral to the frontal plane of the body

11th and 12th: springy end feel
10th: firmer end feel

---

Picture 141: Slide5

Picture 142: Slide6
Surface Anatomy

Transverse Processes decrease in width from T1 caudally

Ventral Aspect

T2: Sternal Notch

Rib 2: manubriosternal junction, level of second ribs
**Ventral Aspect**

**Jugular Notch**

1st rib: palpated from ventral and followed dorsally

2nd rib: at junction between the manubrium and the body of the sternum.

3rd to 7th: palpated from ventral and lateral

σ: nipples → at intercostal space of ribs 4 & 5

**Xiphoid process**

*Picture 145: Slide 9*

**Costal Arch**

Consists of cartilage and synovial connections with the ribs

Area of most pain in the "slipped rib tip" or costal arch syndrome

Reproduce pain = palpate just underneath the costal arch

*Picture 146: Slide 10*
Be Gentle with the Ventral Ribs

Cranial Aspect of the First Rib

Picture 147: Slide11

Picture 148: Slide12
Differential Diagnosis and Manual Therapy of the Thoracic Spine & Ribs

Clinical Examination

Thoracic Spine: Accuracy of MRI

- Incidence of disc lesion is much higher than previously believed
- Less often a radicular problem. Why? High foramen
- Disc lesions can last a long time. Why?
  - Poor circulation
  - Region of relatively little movement
- Small protrusions → dural symptoms (or cord symptoms)
  (Chiu KY, 1995)

Thoracic Spine: Unique Conditions

- Highest Incidence of location for 1° neoplasms
- Highest Incidence of location for metastases
- So...Great need for radiographic exam
- Higher incidence of calcific Δ’s in disc, ligments
- Most frequent incidence of spinal cord signs
  - Cold feet
  - Extra segmental paraspasia
  - Electrical currents

Thoracic Spine: Metastatic Disease

- Prostate and breast cancers
- Cause of many pathologic fractures in T-spine

Thoracic Spine: Primary Tumors

- Osteoblastoma
- Chondrosarcoma
- Multiple Myeloma


Picture 153: Slide5

Thoracic Spine: Sequelae of Metabolic Disorders

Including:
- Osteoporosis
- Cushing’s disease:
  - Hormonal disorder due to high levels of cortisol
  - Rare, affects adults age 20-50
  - Upper body obesity, rounded face, fat around neck, thin arms/legs
- Paget’s disease:
  - Malfunction of bone remodeling; breaks down quickly and grows back softer and larger


Picture 154: Slide6
Thoracic Spine: Fracture

- **Risk for Fracture**, due to compression loading, falls, sports, violent acts, and osteoporosis

- Higher risk for serious sequelae associated with fracture, due to proximity of spinal cord.


Picture 155: Slide 7

---

Thoracic Spine: Fracture

- **Posture** is a strong contributing factor in predisposing patient to thoracolumbar vertebral fracture

- **Increased kyphosis** leads to increased risk for vertebral compression fracture

- Disc degeneration increases vulnerability


www.scoliosis.org

Picture 156: Slide 8
**Thoracic Spine: CT Scan Utility**

- Superior clarity of fractures can be obtained using CT scans, especially of the posterior elements.


**Thoracic Spine: MRI**

- Magnetic resonance imaging (MRI) is superior to both CT and radiographs in depicting soft tissue injury to ligaments, facet joint capsules, and prevertebral space.

Thoracic Spine: MRI

90 asymptomatic volunteers

- Disc protrusion: 53%
- Herniation: 37%
- Annular tear: 58%
- Thecal sac impressed by disc: 29%
- Scheurmann end-plate irregularities: 38%


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Picture 159: Slide11

Thoracic Spine: MRI

- 94 asymptomatic Japanese volunteers mean age of 48.0 +/- 13.4 years

- MRI
  - (1) decrease in the signal intensity of the intervertebral discs (DSI)
  - (2) posterior disc protrusion (PDP)
  - (3) anterior compression of the dural sac (ACD), and
  - (4) disc space narrowing. Association between each degenerative MRI finding and several factors, including age, sex, smoking, sports, body mass index, and degeneration of cervical spine was investigated.


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Picture 160: Slide12
Thoracic Spine: MRI

- 94 asymptomatic Japanese volunteers mean age of 48.0 +/- 13.4 years

RESULTS:
- Forty-four (46.8%) patients demonstrated positive degenerative MRI findings at 1 or more thoracic intervertebral levels
- % of all MRI findings increased with aging


Thoracic Spine: Discography

100 symptomatic volunteers

- 75% Incidence of anular tears, intrinsic degeneration, associated V-body endplate infractions that were painful
- Control levels were typically painless.

History

Thoracic Spine: EXAMINATION

Who?
What?
When?
Where?
Why?
To what extent?
Thoracic Spine: EXAMINATION

Who?
What?
When?
Where?
Why?
To what extent?

General
Spondylodiscitis 4-5 y.o.
due to sepsis 14-19 y.o.
> 50 y.o.

Scheuermann’s Dz, Clinical 12-18 y.o.
Inalterable Kyphosis > 14 y.o.
(Due to bad posture)

Tietze Syndrome 20-45 y.o.
Rib Pathology 20-45 y.o.
Manubriosternal Jx 15-20 y.o.
(due to AS, Reiters, Psoriasis)

Disc Lesions < 50 y.o.
Osteoporotic Comp. Fx 50-60 y.o.
Forrestier’s Disease 50-60 y.o.
Herpes Zoster > 70 y.o.
**Thoracic Spine: EXAMINATION**

**Who?**
- Gender
- Profession or Sports

**What?**
- Forrestier’s Dz
- 1° Nodular OA:
  - spine pain / stiff
  - (+) finger nodules
- Osteoporosis

**When?**
- M > F
- M < F

**Where?**

**Why?**

**To what extent?**
- Heavy UE work:
- Golf
- Rib Lesions
- Spinous Process Fx

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Picture 167: Slide19

Picture 168: Slide20
Thoracic Spine: EXAMINATION

Who?

Pain

Sharp with movement, breathing
Dull aching @ rest & after activity.

What?

Hypo- or hyperesthesia

Dermatomal
or Ventral thorax

To what extent?

Sensory Changes

Rare! (due to overlap)
If (+), think red flag

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Picture 169: Slide21

Thoracic Spine: EXAMINATION

Who?

SC signs

Sign of L’ Hermitte.
Cold Feet
Electrical Currents

What?

Where and How did it start

When?

Acute + Mid T: Disc > ZAJ > Rib
Acute + Upper T: Rib > ZAJ > Disc
Acute + Lower T: Disc > Rib > ZAJ

Where?

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Picture 170: Slide22
Thoracic Spine: EXAMINATION

Onset or Provocation

Who?
What?

When?
Where?
Why?
To what extent?

Pain Change with:

- Head Mvmnt
- UE Mvmnt
- Trunk Mvmnt

C-Spine
Upper-T
Mid T

Remember! Organ pain can change with movement

CSS: Acute Disc > Dural > Ribs
Breathing: Disc vs. CVJ / CTJ

Look for CP! Red Flag!
Thoracic Spine: EXAMINATION

Who?
What?
When?
Where?
Why?
To what extent?

Anterior, Posterior, Medial or Lateral?

First Clear Cervical Spine

<table>
<thead>
<tr>
<th>Region of Pain</th>
<th>Involved Disc Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C3C4</td>
</tr>
<tr>
<td>Mastoid</td>
<td>**</td>
</tr>
<tr>
<td>Temple</td>
<td></td>
</tr>
<tr>
<td>Jaw</td>
<td></td>
</tr>
<tr>
<td>TMJ</td>
<td>**</td>
</tr>
<tr>
<td>Parietal Cranium</td>
<td>**</td>
</tr>
<tr>
<td>Occipital Cranium</td>
<td>**</td>
</tr>
<tr>
<td>Craniovertebral Junction</td>
<td>**</td>
</tr>
<tr>
<td>Neck</td>
<td>**</td>
</tr>
<tr>
<td>Throat</td>
<td>**</td>
</tr>
<tr>
<td>Upper Back</td>
<td></td>
</tr>
<tr>
<td>Trapezius</td>
<td>**</td>
</tr>
<tr>
<td>Top of Shoulder</td>
<td></td>
</tr>
<tr>
<td>Upper Extremity</td>
<td>**</td>
</tr>
<tr>
<td>Anterior Chest</td>
<td>**</td>
</tr>
<tr>
<td>Scapula</td>
<td>**</td>
</tr>
</tbody>
</table>

First Clear Cervical Spine

**Chronic Cervical Internal Disc Disruption, IDD:**

Most pain with:
- Full flexion, & or
- Retraction + extension
- (+) Cervical SB end-feel test

First Clear Cervical Spine

**Cervical Zygaphyseal Joint, ZAJ:**

Most pain with:
- Rotation, Ipsilateral SB, Flex
  - Pain at contra side = lower cervical joint capsule irritation
- Rotation, Contra lateral SB
  - Pain at contra side = cartilage pathology
First Clear Cervical Spine

Cervical Uncovertebral Joint, UVJ:

Most pain with:
• SB, Ipsilateral Rot
  → Pain at Ipsilateral & or Contra side
  = capsule irritation

• SB, Contra Rot
  → Pain at Ipsilateral side = cartilage pathology

---

Thoracic Spine: EXAMINATION

Who?
What?
When?

Where?
Why?
To what extent?

Pain

• Local:
  Posterior IDD, Protrusion
  ZAJ arthropathy
  CVJ / CTJ arthropathy

• Referred, Non radicular
  Chronic IDD
  ZAJ arthropathy

• Referred, Radicular
Prevalence of Internal Disc Disruption

**Group 1:**
60 asymptomatic subjects  
31 Men, 29 Women  
Age: 40 (24-65).

**Group 2:**
30 subjects back pain, but without thoracic pain.  
Age: 46 (17-86).


---

**Results:** Groups 1 and 2

- Intervertebral degeneration and/or anulus rupture: 73%
- Disc degeneration at several levels: 55%
- “Bulging disc” at at least 1 level: 53%
- Spinal cord deformation due to protrusion: 29%

Wood et al. 1995
Internal Disc Disruption

Results: Groups 1 and 2

- End plate changes (such as Scheuermann): 38%
- Of the 34 subjects with changes, such as Scheuermann: each had at least 1 disc prolapse
- Of the 56 individuals without such changes: only 25% had a disc prolapse

Wood et al. 1995

Internal Disc Disruption

Group 3:

- 31 patients with thoracic pain.
  Age: 39 (19-80). 18 patients had a disc protrusion, confirmed at surgery

Wood et al. 1995
Internal Disc Disruption

Results:

• Multiple degenerative changes: 84%

• Endplate changes more prevalent in this group than in comparison to groups 1 and 2: 68%

Wood et al. 1995

Thoracic ZAJ

Thoracic ZAJ


Thoracic Spine: EXAMINATION

Note:

- Dermatomes are not purely intercostal; Occupy 2-3 intercostal spaces
- IC pain: NO Δ with motion: Herpes Zoster
- Sternal Pain with inspiration: Thoracic, not heart
- Unilateral organ can produce bilateral pain
- Pain in UE’s & Head: T4 Syndrome
Thoracic Spine: EXAMINATION

Etiology?

- Macrotrauma:
  - Non-Contact?
  - Versus
  - Contact?

Who?
What?
When?
Where?
Why?
To what extent?


High Velocity Macrotrauma:
- Axial Load: disc lesion vs. compression fracture
- Rotatory: disc vs. rib fracture
- T6 to T12: increased disc lesions due to reduced rib support
Thoracic Spine: EXAMINATION

Etiology?

Who? Combined Rib + Vert. Body Fx → Early Degeneration & Instab
What? Seat Belt in MVA →
When? Persistent lateral or anterior pain
Where? Normal Radiographs; (+) Bone Scan will show occult Fx of rib
Why? To what extent?


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Picture 191: Slide43

Thoracic Spine: EXAMINATION

Etiology?

Who? Microtrauma: Eg…Golfing
What? A persistent disc can be the result of repetitive rotation
When? Where?
Why? To what extent?

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Picture 192: Slide44
Thoracic Spine: EXAMINATION

Who?  What?  When?  Where?

Why?
To what extent?

Etiology?

- Apparently insignificant act: Look for a history!
- Unknown etiology:
  Persistent Protrusion vs. Serious Pathology.

For How Long?

- Small Protrusion: Possible serious spinal cord involvement
- Radicular Symptoms with Acute Disc: Large disc protrusion!
**General Health**

**Cortisone Use**
- Long term asthmatics: ↑d risk for osteoporosis

**Diabetes**
- Diabetic thoracic polyradiculopathy
- Abdominal Pain due to intercostal neuralgia

Longstreth GC (1997)

---

**General Health**

**Rheumatoid Arthritis**
- Can induce discitis
- Source: CVJ

**Osteoporosis**
- 50% of all vertebral fractures in T-spine
**General Health**

**Visceral pathology**
- Fever Chills, Nausea > 1 week
- Unexplained weight loss, anorexia, malaise
- Altered bowel habits
- Rectal or vaginal bleeding
- Cancer history

**General Health**

**Surgical History**
- Thoracotomy
- Gynecological: Osteoporosis; eventual rib Fx.
- Coronary Artery Disease:
  - Bypass grafting; Rib dysfunction due to rib spreading
Questions?
Differential Diagnosis and Manual Therapy of the

**Thoracic Spine & Ribs**

Clinical Examination

---

**Thoracic Spine: INSPECTION**

- **Palpation**
  - Tenderness @ Ant. Ribs 2 & 3: Tietze (costochondritis)
  - Spinous Processes: Asymmetry = Rule
  - Finger Rule

- **Swelling**
  - Profile for upper traps; 1st rib position
  - Supraclavicular: Plexus vs. 1st rib
  - Full T-spine hypertonus: **Alert**
  - Manubriosternal Junction: Ankylosing Spondylitis
Thoracic Spine: INSPECTION

**Additional Observed Features**

- Everybody has a scoliosis
- Antalgic kyphotic position: acute disc pathology

**Kyphosis**

- < 30° is normal
- > 30° is abnormal; possible Scheuermann’s
- > 50° Indication for surgical correction

---

Thoracic Spine: Active Sitting Tests

**A. Flexion**
- with neck flexion (Neri)

**A. Extension**

**A. Sidebending (L)**

**A. Sidebending (R)**

**A. Rotation (L)**

**A. Rotation (R)**

(Quantity, Quality, and Provocation)
**Thoracic Spine: Passive Sitting Tests**

- P. Rotation (L) with neck flexion (Neri)
- P. Rotation (R) with neck flexion (Neri)
- P. Sidebending (R)
- P. Sidebending (L)

(Quantity, Quality, and Provocation)

---

**Thoracic Spine: Resistive Sitting Tests**

- Ω Sidebend (L)
- Ω Sidebend (R)
- Ω Rotation (L)
- Ω Rotation (R)

**Reflexes**
- DTRs of LE
- Babinski
Thoracic Spine: Supine Tests

- Abdominals
- Rectus
- Obliques
  (Quantity and Provocation)

Abdominal Reflexes

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Picture 206: Slide 7

Thoracic Spine: Prone Tests

A. Extension
  (Quantity, Quality, and Provocation)

P. Extension
  (Alternate technique for passive extension)

Resisted Extension

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Picture 207: Slide 8
Thoracic Spine: Prone Tests

Spring Tests
Spinous Processes (SPs)
Transverse Processes (TPs)
(Quantity and Provocation)

TP Test
SP Test

Thoracic Spine: Extra Tests

**Slump Test (L)**
**Slump Test (R)**

Rotate to each side for each test on each LE
Both sides are tested regardless of which side the patient has pain

When (+) = “tension problem”
(Quantity, Quality, and Provocation)

Don't forget Exhalation!

Picture 208: Slide9

Picture 209: Slide10
Thoracic Spine: Active/Passive Tests

**Quantity?**
How far do they go?

**Quality?**
Smooth transitions, end feel

**Provocation?**
Does the test provoke their symptoms?

**Most important question:**
Was it their pain?
Thoracic Spine: Active Flexion

**Pain & or Limitation?** Possible acute disc

**Quality & Provocation:**
- ↑ d pain with expiration: disc
- ↑ d pain with inspiration: ribs
- ↓ d pain with inspiration: disc
- (+) Neri: Disc pathology

---

Thoracic Spine: Active Extension

**Pain & or Limitation?** Possible acute disc

- Not likely ZAJ; Why? S-processes

**Quality & Provocation:**
- ↑ d pain with inspiration: disc
- ↑ d pain with expiration: ribs
- ↓ d pain with expiration: disc

---

Thoracic Spine: Active Sidebend

Pain & or Limitation? Ipsi CVJ vs. Rib
Not likely disc; Why? ↓’d motion
Not likely ZAJ; Why? No stress

Quality & Provocation:
↑’d pain over iliac crest:
  costo-iliac compression

Picture 214: Slide15

Thoracic Spine: Active/Passive Rotations

Pain & or Limitation? Acute/Recurrent disc
Pain: ipsi or contralateral to movement?
Not likely rib; Why? ↓’d constraint
Possibly ZAJ; Why? capsule stress
  Rule out disc 1st!
(+ ) Neri: Disc-related

Picture 215: Slide16
Thoracic Spine: Passive Sidebend

Pain & or Limitation?
   Possible ipsi CVJ
   Also (+) for rib fracture
      (with rib squeeze)

Thoracic Spine: Resisted Rotation, Sidebend

Quantity  Strength
Provocation
   Not likely (+); possible...
      Primary muscular lesion
      Fracture
      Acute disc
      Serious pathology
Thoracic Spine: Neurological

**Reflexes (DTR's, Babinski)**
- Very Important! Look for ↑ response.
- Suggests SC lesion: Disc or serious pathology

**Resisted Abdominals**
- T6-T10
- Looking for disc prolapse

**Abdominal Reflex**
- Looking for ↓; Suggestive of prolapse


---

Thoracic Spine: Neurological, cont...

**Acute Onset**
- Disc
  - (serious pathology)

**Gradual Onset**
- Disc (microtraumatic)
- Malignancy (more important to rule out!)
- Neurinoma
- 1° tumor or metastases

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Thoracic Spine: Prone Tests

**Active Extension**
- Quantity: Full ROM
- Quality: Is kyphosis maintained?
- Provocation: Not likely; Possible disc

**Resisted Extension**
- Quantity: Strength
- Provocation: Not likely (+); Possible...
  - 1° Muscular
  - Fracture
  - Acute disc
  - Serious pathology

---

Thoracic Spine:

**Passive Extension**
- Quantity: Full ROM
- Quality: Endfeel?
- Provocation: Possible Disc

**Spring Tests**
- Level identified
- Spinous process vs. transverse process

**Slump**
- Provocation?
- Tension Sign – Disc
- Mobility Sign – Adhesion (if recurrent)
Thoracic Spine

Interpretation and Pathology

Most Important Question

Is there a limitation?

2nd Question: Capsular Pattern (CP) vs. NonCapsular Pattern (NCP)

Thoracic Spine “Capsular Pattern” =
- Extension is more limited & painful than flexion;
- Symmetrical SB limit with = pain;
- Symmetrical rotation limit with = pain.
**Most Important Question**

**Acute Onset:**
- Traumatic: Synovitis of entire segment(s)
- Nontraumatic: Discitis (younger)
  Malignant tumor

**Nontraumatic, Gradual Onset:**
- Systemic disease (possible younger)
- Arthritis (older)

**Capsular Pattern**

**Spondylodiscitis**
- Adults > 50 y.o.; women = men
- Due to hematogenous inflammation of disc
- Central thoracic pain
- Pain radiation laterally & or into LE’s
- CP limitation
- (+) Percussion & or heel drop
- (+) MRI or CT

**Management:** Bedrest + Antibiotics
**Capsular Pattern**

**Malignant Tumor**
- All ages; women = men
- Commonly due to metastases from:
  - bronchial carcinoma
  - Pancoast tumor
- Severe central thoracic pain
- Intercostal neuralgia
- CP limitation
- (+) Percussion & or heel drop
- (+) MRI or CT

---

**Capsular Pattern**

**Arthritis**

**CP Pathologies to be treated** with joint specific techniques, JST

1° Macrotraumatic Arthritis

2° Microtraumatic Arthritis
Capsular Pattern

Arthritis

CP Pathologies contraindicated JST

1° Macro-traumatic arthritis with instability
Will typically be treated with surgery
Should not be surgically repaired earlier than 2-4w post-trauma
Nontraumatic arthritis: other systemic disease
Spondylodiscitis

Capsular Pattern

Arthrosis

Pathologies to be treated with JST

1° Arthrosis without instability
1° Activated Arthrosis without instability
2° Arthrosis post fracture
Non Capsular Pattern

**Acute Onset**

- Large Axial Rotation Limit: Acute disc
- Large SB Limit: Pleuritis
- Large Extension Limit: Compression fracture

**Gradual Onset**

- Recurrent/chronic disc
- Unilateral ZAJ synovitis / chondropathy
- Unilateral ZAJ spondylosis, spondylarthrosis
- Costovertebral joint, costotransvers joint pathology
- Visceral
Non Capsular Pattern

Traumatic Compression Fracture

- All Ages; women = men
- Due to axial trauma with flexion
- Acute local pain (lower T)
- (+) CSS; and or (+) Breathing
- Basic Clinical Exam unavailable (not tolerated due to severity of pain)
- Seldom found neuro signs
- (+) MRI, CT, or Conventional X-ray

Management: Bed rest; return to activity

Non Capsular Pattern

Spontaneous Compression Fracture

Adults > 60 y.o.; women > men
Due to osteoporosis
Acute local pain (lower T);
  Chronic pain follows
(+) CSS; & or (+) pain w/ breathing
Extension & flexion limits
(-) neuro signs
(+ ) MRI, CT, or Conventional X-ray

Management: Bed rest; return to activity
Non Capsular Pattern

Thoracic Postural Syndrome

6-40 y.o.; women > men
- Prolonged flex:
  - Overload to muscles & ligaments
  - Midline pain:
    - Pain resolves with activity & lying down
- Possible (-) or pain at end range (normal ROM)
- Possible (+) MRI or CT


Non Capsular Pattern

Thoracic Postural Syndrome

- Management:
  - Education
  - Tactile cues (taping)*
  - Ergonomic alterations
  - Stabilize w/ SenMoCOR™
  - Activation

Intervertebral Disc

With advent of MRI, incidence much greater than once thought. Mean age = 40 y.o. (In many cases these can be asymptomatic)

**Etiologies:** Degeneration, Trauma, Lifting, Exercise, MVA

**Locations:** Especially at Mid to lower T-Spine


Intervertebral Disc

Acute Disc-Related Disorder

Potentially mimics symptoms associated with cardiac, pulmonary, GI, renal, or psychiatric disorders

Non Capsular Pattern

Acute Disc: Endplate Fracture

- Younger population
- Traumatic
- Noncapsular Pattern
- Possibly not Clinical in 4-5 days
- Spontaneous resolution of symptoms

Acute Disc: Posterolateral Protrusion

- 30-45 y.o.; \( \frac{\text{♀}}{\text{♂}} \)
- Due to axial and/or rotational trauma
- Unilateral local and nonradicular pain
- (+) CSS; and or (+) breathing
- One rotation more painful and or limited
- (+) Dural tests (often)
- (+) MRI or CT
Non Capsular Pattern

Acute Disc: Posterolateral Prolapse

- 30-45 y.o.; $\varphi = \sigma$
- Due to trauma
- Unilateral Local and nonradicular pain
- (+) CSS
- Painful & limited flexion/extension
- Asymmetrical rotation limitation(s)
- (+) Dural tests

Thoracic Disc Herniation

- $\sigma = \varphi$
- 20 to 50 year olds
- 0.25 to 1% of all disc herniations
- Majority are central or centrolateral, below T7

- **Calcification** important complication (30% to 70% of disc herniations; 5% to 10% of these are associated with intradural extension)

Signs and Symptoms

- 25% associated with trauma
- 76% had pain (thoracolumbar, radiculopathy)
  - 61% sensory (paresthesia, dysesthesia, complete loss)
  - 61% motor (paraparesis 3x greater than monoparesis)
- Myelopathy
- 24% Bladder dysfunction (sense of urgency)


Non Capsular Pattern

Acute Disc: Centerolateral Protrusion / Prolapse

- 25-45 y.o.; ♂ = ♂
- May be due to severe trauma (25%)
- Severe central and radicular pain
- (+) CSS; and or (+) breathing
- (+) Spinal cord Signs
  - L’ Hermitte’s
  - Electric Shocks
  - Spastic Gait
  - Cold Feet
Non Capsular Pattern
Acute Disc: Centerolateral Protrusion / Prolapse

- ROM limits depend on severity
- (+) Dural tests (often)
- (+) LE reflexes (hyperreflexia)
- (+) MRI or CT

Management
Bed Rest, gentle traction
Surgery if spinal cord signs

Scheuermann

- Avascular necrosis of the apophyseal ring
- Inhibited enchondral ossification due to intravertebral disc herniations
- Persistent anterior vascular grooves
- Juvenile osteoporosis
- Abnormal collagen-proteoglycan ratio in endplate
- Autosomal dominant inheritance pattern
- Mechanical factors play a significant role

Scheuermann

- Upper limit of normal is 45°
- 1% to 8% of population
- Presents from 8 to 12 years, more severe fixed form at 12 to 16 years
- Male = female
  - In 50%, thoracic pain. Usually seek help for deformity
- Those seeking help for pain, usually adult

Scheuermann

**Progression?**

- Unknown
- Not inevitable!
- Confused by normal progression with aging: from 20° in childhood to 40° in adults
Scheuermann: Treatment

Initial:
- Assess degree, pain, self esteem
- Physical therapy:
  - postural training
  - strengthening trunk extensors, shoulder external rotators, neck extensors
  - Check for hip flexor contraction

Bracing:
- Indicated for the skeletally immature
- At least 45°, up to 65° curve
- Pain
- Progression of curve
- How long?
  - 14 months fulltime, 18 months part-time
Scheuermann: Treatment

Average In-brace correction = 16.5 degrees

Treatment is almost always successful in patients with kyphosis between 55° and 80° if diagnosis is made before skeletal maturity.


Scheuermann: Treatment

Surgery

- Indicated for curves > 75°, associated with pain, and no response to conservative treatment
- Approach: anterior spinal release and fusion, disc excision, instrumented posterior spine fusion, usually T3-L2
- Complications: death, neurological deficits, hardware failure, infection, pneumothorax, pulmonary emboli, persistent pain
Adolescent Idiopathic Scoliosis

- Complex 3-D anomaly of the spine
- Involving deviations in frontal plane, sagittal plane, rotations in transverse plane, alterations of the rib cage
- Local structural deformities: pedicles, spinous and transverse processes, vertebral bodies, intervertebral discs


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Adolescent Idiopathic Scoliosis

- Most common spinal deformity, curves exceeding 10° have 3% prevalence.
- Cause unknown
- Risk of progression unknown
  – More likely in girls than boys 7:1
  – During growth spurt
- Associated factors to progression
  – Poor mesomorph development
  – Low bone mineral density

LeBlanc et al. morphologic discrimination among healthy subjects and patients with progressive and nonprogressive adolescent idiopathic scoliosis. Spine. 1998; 23,10.1109-1116

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AIS: Treatment

Conservative: Bracing

Predictive factors for success

- < 35° curve
- Able to wear brace > 18 hours per day
- Correction of scoliosis and rotation (primary correction of 30-50% in the brace during the 3 months)
- Flexibility of the sagittal profile


Picture 255: Slide33

AIS: Treatment

- Conservative: Physical therapy?
  
  … significantly more likely to fail complex, sensory-challenged balance tasks when the somatosensory system was challenged by an unstable position of the feet, particularly when the eyes were closed

  Schrot method


Picture 256: Slide34
AIS: Treatment

**Surgical:**
- Fusion: anterior, posterior, or both.
- ...high variability in selection of both operative approach and fusion levels confirms the current lack of standardized treatment paradigms


Picture 257: Slide35

**Schmorl’s Nodes**

- Herniation of disc substance through cartilaginous plate of intervertebral disc into body of the adjacent vertebra
- Reported to be the most common lesion of the intervertebral discs, of the whole spine


Picture 258: Slide36
Schmorl’s Nodes

Pathogenesis:
- Developmental due to ossification gaps, vascular channels
- Degenerative, weakness in cartilage endplate
- Pathologic diseases
- Traumatic, acute and chronic, disc herniation through the endplate


Picture 259: Slide37

Schmorl’s Nodes

Acute trauma: axial load
- Motorcyclists, falling off a ladder, jumping from a height
- Not seen on plain radiographs (only seen months later after the typical osseous casing as formed)
- Most commonly between T8 and T12


Picture 260: Slide38
Schmorl's Nodes

Chronic trauma:
- Associated with jumping in sports such as gymnastics and wrestling
- Most commonly between T8 and T12
- Can give rise to early disc degeneration


Mock Clinics

Thoracic Spine
Mock Clinic 1

Patient: male, 34 years, professional golfer with T-spine pain of 2 years duration. Pain began with 1st golf on circuit.

Pain is (R) central T-Spine. Occ. stabbing pain in the subscapular region with rotation. Commonly aching pain after golf, lasting through the next morning.

C.S.S.: (-), VAS: 4/10, X-ray:(-)

Diagnosis: strain of the right rhomboids

He tried to stretch it out on his own. Stretching increased the pain. Patient is relatively flexible. Treated by another PT with Myofascial techniques with no permanent change.
Mock Clinic 1

BCE

Rot (L): (+) mild limitation; pain at end range; (+) Neri

(+)(R) Slump with (L) rotation

Mock Clinic 2

Patient: male, 18 years, student and football player with T-spine pain of 6 months duration. Pain began when he was speared in the interscapular region during a football game. He was treated 1 mo post insult with Estim, US, MoistHeat, & stretch (which ↑ d pain).

Pain is midthoracic, (B) with (L) > (R). Breathing, sitting, weightlifting and driving make the pain ↑.
Mock Clinic 2

BCE
- Flexion: Mild limit; Mod pain on (L)
- Ext: Mod limit; Severe pain (L)
- (L) SB: Mild limit; Mild pain (R)
- (L) Rot: Mod limit; Mod pain (L)
- Ω (L) Rot: Mod pain (L)

Extra Examination
- Rib Mobility
  - (R): 3, 4, 5 locked in insp
  - (L): 5, 6 locked in insp
- Rib Provocation
  - (R): (++) Rib 3, 4, 5
  - (L): (++) Rib 5, 6
- Spring Test: S-process \( \rightarrow \) T6 (+++); T7 (++)
- T-process \( \rightarrow \) T7 (+++)
Mock Clinic 3

Patient: female, 16 years, student and snowboarder with T-spine pain of 6 months duration. Pain began with fall / tumble while snowboarding. She doesn’t remember what happened. She was treated with an epidural cath series; pain ↑’d and now she can’t sit.

Pain is (R) central T-Spine. Commonly aching pain after sitting > 5 min, lasting for several hours. Occ. sharp pain in the interscapular region with rotation. She cannot sit. She has quit school and is now homeschooled. She cannot sit!

C,S,S : (-), VAS: 4/10, X-ray:(-)

Diagnosis: strain of the thoracic spine.

She tried to stretch and exercise.

Stretching increased the pain.

Patient is relatively flexible.
Mock Clinic 3

BCE

Completely (-)

Extra Test:
Slump R with R Rot; pain (+)
Thoracic Disc Management

Disc Management

Thrust Techniques: Contraindications
- Malignancy
- Infection
- Compromised pulmonary system (e.g., COPD)
- Evidence of Prolapse with Dural test findings
- Severe neurological - cord signs
- (bowel/bladder dysfunction, sexual dysfunction, pathological reflexes, discoordination, etc.)
- Acute strains or sprains
- Unhealed fracture
- Prolonged use of corticosteroids

Disc Management

Thrust Techniques: **Contraindications**

- Pregnancy
- Osteoporosis
- Claustrophobia
- Capsular pattern with no known cause
- Unexplainable pain during the night
- Use of anticoagulants
- Symptoms are elicited or worsen during the treatment


---

Disc Management

Thrust Techniques: **Precautions**

- Use of birth control pills
- General hypermobility
- Anomalies and fusion of the vertebrae
- Negative functional examination
- Anxiety
- Increased pain with technique/traction

Treatment for Thoracic Spine Syndromes

Disc Related

Pathology
- Endplate fracture
- Acute internal disc disruption
- Protrusion
- (Prolapse)

Acute central or paraspinal pain, 0 to 1 week
- Severe posteroaxial/posterolateral pain that can be provoked with mechanical testing; increases with thoracic (and arm) motion, and with breathing.
- Acute onset.
- Only supine lying decreases pain.

Picture 277: Slide5

Picture 278: Slide6
Treatment for Thoracic Spine Syndromes

Disc Related

Subacute central or paraspinal pain

Moderate to severe postero-central/posterolateral pain that can be provoked with mechanical testing.

- Increases with thoracic (and arm) motion, and with breathing.
- Acute onset.
- Patient is comfortable in the upright position

Treatment

1. Soft tissue techniques in flexion or extension and painfree rotation
2. Axial separation in 3-D if unable to correct to neutral
3. Axial separation in neutral sitting
Treatment for Thoracic Spine Syndromes

Soft Tissue Treatment

Transverse Friction of the Rotatory Muscles

Local transverse friction of the vertebral and paravertebral musculature can be applied as a method of pain relief (temporarily), after which mobilizations can be performed. Generally, in the thoracic spine the rotatory muscles can cause local tenderness. They run in a direction from cranio-medial to caudolateral. Patient lies prone (with a firm pillow underneath the trunk). Therapist stands next to the patient. The friction is performed with the thumbs (transverse to the running of the muscles fibers). This technique can be also performed with the middle and index fingers (as shown here).

Picture 281: Slide9

Treatment for Thoracic Spine Syndromes

Soft Tissue Treatment

Transverse Stretching of the Erector Spinae

Patient lies prone (with a firm pillow underneath the trunk). Therapist stands next to the patient. The technique can be performed with the thumb, the heel of the hand, the thenar eminence, or the thumb reinforced by the thenar eminence of the other hand. The thumb hooks against the erector spinae at the segment of the thoracic spine being treated. A transverse stretch is performed by pushing either away from or toward the spinal column, without rubbing over the muscle. This technique can be performed in general manner or per segment.

Picture 282: Slide10
Treatment for Thoracic Spine Syndromes

Soft Tissue Treatment

Transverse Stretching of the Erector Spinae + Extension Rotation Coupled Movement Pattern

Patient lies sidelying (with a firm pillow underneath the trunk). Therapist in the front of the patient. With the fingers and with the entire ulnar side of the caudal hand, the therapist hooks the medial edge of the upper-lying erector spinae muscle. The other hand has contact with the ventrocranial aspect of the upper lying side of the thorax. If the patient’s arms are crossed in front of the trunk with the hands resting on the shoulders, the therapist can use the upper-lying hand as a point of support – pushing in dorsal direction, while attempting to bring the erector spinae in the opposite direction.

International Academy of Orthopedic Medicine - Diagnosis Precisely, Treat Effectively

www.iaom-usa.com

Picture 283: Slide11

Treatment for Thoracic Spine Syndromes

Soft Tissue Treatment

Transverse Stretching of the Erector Spinae + Flexion Rotation Coupled Movement Pattern

Patient lies sidelying (with a firm pillow underneath the trunk). Therapist in the front of the patient. With either thumb or the thenar eminence of the caudal hand, the therapist pushes against the lateral edge of the upper-lying erector spinae. The other hand is placed on the craniodorsal aspect of the patient’s upper-lying shoulder. The therapist’s cranial hand moves the patient’s trunk in a ventral direction, which results in flexion, sidebend and ipsilateral rotation. At the same time, the other hand attempts to pull the erector spinae in the opposite direction.

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Picture 284: Slide12
Treatment for Thoracic Spine Syndromes: Separation Technique

**Disc Related**
Recurrent central or paraspinal pain, 6 to 12 weeks

1. Soft-tissue techniques, for example
   - Prior to ipsilateral rotation technique
   - Prior to contralateral rotation technique

2. Axial Separation in Sidelying
   Performed in 3-Dimensional
   Ipsilateral rotation
   Contralateral rotation

3. 1-Person, 2-Person, 3-Person

---

Treatement for Thoracic Spine Syndromes: Separation Technique

**Disc Related**
Recurrent central or paraspinal pain, 6 to 12 weeks

**Axial Separation in Sidelying**
Performance in 3-Dimensional
Painful side up
Ipsilateral rotation technique
(illustrated here: right rotation technique for right thoracic pain)
Treatment for Thoracic Spine Syndromes: Separation Technique

**Disc Related**
Recurent central or paraspinal pain, 6 to 12 weeks

**Axial Separation in Sidelying**
Performed in 3-Dimensional
Painful side up
Contralateral rotation technique
(illustrated here: Right rotation technique for left thoracic pain)

---

**Treatment for Thoracic Spine Syndromes: Separation - Traction**

**Mechanical Traction**

**Upper Thoracic (T1 - T4 or T5)**
Cervical Traction set up
Flex head and C-Spine, so to lock it
Daily x 10 days

**Mid Thoracic (T5 - T8 or T9)**
Lumbar Traction set up; Pillows under T-spine
Thoracic belt at the axilla; Pelvic belt above pelvis
Pull from cranial, 60-80#
Treatment for Thoracic Spine Syndromes

Primary Disc Related

Central or paraspinal pain

**Mechanical Static traction**

- One belt at the lumbar spine, above the iliac crests.
- The other belt underneath axillae.
- The “pulling unit” from the traction is positioned higher, so that the line of pull is in flexion.
- Patient lies with upper thoracic spine on pillows in order to support the thoracic kyphosis.
- Traction for 30 to 40 minutes

---

Treatment for Thoracic Spine Syndromes: Separation - Traction

**Midthoracic Traction**

- Patient supine
- Semi-reclined
- Hips, knees slightly flexed
- Pelvis stabilized
- Pull from cranial
Treatment for Thoracic Spine Syndromes: Separation - Traction

**Midthoracic Traction**

- Patient supine
- Semi-reclined
- Hips, knees extended
- Pelvis stabilized
- Pull from cranial
Treatment for Thoracic Spine Syndromes: Separation - Traction

Midthoracic Traction

- Patient prone
- Pillows under chest
- Hips, knees slightly flexed
- Pelvic fixed
- Pull from crania

Midthoracic Traction

- Patient supine
- Hips, knees flexed to 90°
- Wedge under pelvic
- Pelvic fixed
- Pull from cranial; 60-80#
Treatment for Thoracic Spine Syndromes: Separation - Traction

Lower Thoracic

T9 - T12

- Lumbar traction set up
- The hips are flexed as much as possible in order to “lock” the lumbar spine.
- Thoracic belt at the axilla; Pelvic belt above pelvis
- 90° / 90° set-up
- Pull from below: 100#/Pull from cranial: 60-80#

Treatment for Thoracic Spine Syndromes: Note

Possibly no long lasting effect until after 4 to 6 visits
Do not perform axial separation mobs and traction on the same day!
Differential Diagnosis and Manual Therapy of the Thoracic Spine & Ribs

Pathoanatomy

Ribs

Picture 299: Slide 1

Ribs: Bony

Picture 300: Slide 2
Ribs: Bony

Horizontal Kinematic Chain

Disc
2 pairs ZAJs
Ribs
CVJ
CTJ
CostoChondral
CostoSternal

Picture 301: Slide3

Ribs: Bony

Horizontal Kinematic Chain

Rib Head
3 facets
3 connections

Consequence:
J’d post-lat protrusions

Picture 302: Slide4
**Ribs: Bony**

**Vertical Kinematic Chain**

1 motion segment
6 ribs

---

**Ribs: Costotransverse Joint**

**Roles**

- Stabilizes the rib segment
- Influences rib motion
- Orientation linked to T-process

---
Ribs: Costotransverse Joint

Roles

- Ribcage stiffness affects segmental stiffness
- Limits segmental motion


Ribs: Costotransverse Joint

Pain generator

- 8 subjects
- Asymptomatic
- Difficult injection
- Provoked deep dull ache

Ribs: CTJ Sagittal

**Upper 6 Ribs:** Rib is ventral to T-Process

**Ribs 7-10:** Rib is ventral-cranial to T-Process

---

Ribs: CTJ Transversal

**Orientation**

Upper Ribs
Middle Ribs
Lower Ribs

---

Picture 307: Slide9

Picture 308: Slide10
Ribs: Costal Facets

Costovertebral

Ribs: CVJ Atypical

T1
T9
T10
T11
T12
Ribs: CVJ Typical

Ribs: Ligaments

Costovertebral
- Radiate ligament
- Costotransverse ligaments
- Intra-articular ligament
- Additional ligamentous band
- Superior & inferior joint compartments
Ribs: Capsuloligamentous

Costotransverse

- Fibrous capsule
- Superior costotransverse
- Accessory
- Costotransverse
- Lateral costotransverse

Ribs: Ligaments

Ligaments
- Radiate Ligament
- Costotransverse Lig’s
- Articular Capsule
- Lat. Costotransverse Lig.
Ribs: Associated Myofascial Structures

• From neck, abdomen, upper thorax & back to include:
  – Scalenes, pectorals, serratus anterior, serratus posterior superior, serratus posterior inferior, iliocostalis, quadratus lumborum

Ribs: Associated Myofascial Structures

• Local and deep:
  – Levator costarum
  – Intercostals
Ribs: Kinematic Chain CVJ / CTJ

Roles

- Influences Rib Motion with Breathing
- Distinction
  Lower vs. Upper

Ribs: Breathing Chain

Axis Orientation

Upper Ribs
Lower Ribs
**Ribs: Axes of Rotation – Normal Respiration**

- **Ribs 1 & 2**
  - don’t move

- **Ribs 3 to 6**
  - move up and forwards

- **Ribs 7 to 10**
  - move up and laterally

**Sternum**

**Between full inspiration and expiration**

- the suprasternal notch may move 3.1 cm
- excursions at the superior (3.4 cm) and inferior (3.7 cm) ends are compensated by changes in the sternal angle.
Costochondral Junctions and Costosternal Joints

1st, 6th, & 7th ribs: Synchondrosis

2nd through 6th or 7th ribs: Synovial Joint

7th or 8th through 9th ribs: Interchondral Joints

Classification

Anatomical Morphological

Ribs: Connections

Ribs: Mechanics Kinematic Behaviors

Ribs 1-7
• Direct Sternal
• ↑d F / E stiffness
• No Δ in rot.

Ribs 8-10
• Indirect sternal
• ↑d rot stiffness.
• ↑d F / E

Ribs 11-12
• No sternal

Picture 321: Slide23

Picture 322: Slide24
TIME FOR QUESTIONS
Differential Diagnosis and Manual Therapy of the

Thoracic Spine & Ribs

Clinical Examination
RIB

Picture 324: Slide 1

Thoracic: BCE

BCE = only Ribs 5-10 can be provoked

Test & Treat Disc 1st!!!
Thoracic: BCE

BCE = only Ribs 5-10 can be provoked

Active Flexion:

By adding inspiration/expiration various structures can be further isolated:

- ↑′ d pain with expiration = disc, because spine goes further into flexion which further loads disc
- ↑′ d pain with inspiration = ribs, because spine no longer at end-range flexion and ribs are moving into inspiration
- ↓′ d pain with inspiration = disc, because disc now unloaded due to no longer being in end-range position

Thoracic: BCE

BCE = only Ribs 5-10 can be provoked

Active Extension

- ↑′ d pain with inspiration: disc, because spine goes further into extension
- ↑′ d pain with expiration: ribs, because spine no longer at end range extension and ribs have moved into expiration
- ↓′ d pain with expiration: disc, because disc now unloaded due to no longer being in-end range position
Thoracic: BCE

BCE = only Ribs 5-10 can be provoked

Active Sidebending **towards** the pain
↑‘d pain with inspiration: ribs

Active Sidebending **away** from the pain
↑‘d pain with expiration: ribs

If the only provocation: Think fracture

---

Ribs: Mobility and Position Testing

---

Picture 328: Slide5

Picture 329: Slide6
1st Rib: Cervical Rotation Lateral Flexion (CRLF; Lindgren) Test

1st Rib Spring Test: Costovertebral

Picture 330: Slide7

Picture 331: Slide8
Position Test in Sitting: Ribs 2-10

Position Test for Costovertebral Joint:
- Patient is flexed, SB and Rot contra to testing side
  - (ie, Flexed, L SB, L Rot for testing right side)

Springing Test in Sitting: Ribs 2-10

- SB right & rotate left
- Spring ventral lateral with heel of hand
- Testing costotransverse joint
Rib Testing

Can also perform spring testing in prone

Pathology: Tietze Syndrome or Costochondritis

- Chondrosternal inflammation at rib 2 or 3
- More often female, (L) side
- Linked to excessive UE movement pulling on rigid upper ribs
- Management: Injection or ionto; Transverse friction to costochondral junction; JST to rib joints, upper T-spine
Pathology: Synovitis

Chondrosternal
Chondrocostal
Management:
- Injection or ionto;
- Transverse friction to costochondral/chondrocosternal junction, intercostals;
- JST to rib joints, upper T-spine

Pathology: Costal Arch

Slipping Rib Tip Syndrome

- Vague Epigastric Pain; ↑’d pain after eating, sitting, cannot lean against lower rib cage
- Etiology: Cartilage fracture, subluxed rib (inward), Intercostal neuropathy
- Most commonly at rib 8, but also at rib 9 & 10.
- Management: Injection, Postural management
Costovertebral Arthrosis

- Many rib problems are subclinical.
- Arthrosis = mobilization is no longer possible
- Many middle-aged = bony bridges at the ventral part of the joint
- Proximity of the sympathetic network at the ventral aspect of the head of the rib = osteophytes can create irritation (sympathetic reactions)

Reference of pain:
- Chest, abdomen, flank, paravertebral thoracic

Initial diagnoses
- Renal colic, pulmonary embolism, spinal tumor, gastrointestinal, pleurisy

Clinical findings
- Pain triggered by cough or trunk rotation
- Palpation or mobilization triggers the patient’s pain
- Improvement after local injection, or triggering of pain during arthrography

Rib Stress Fracture

Symptoms may be confused with a muscle strain

- Key = pain with deep breathing or coughing
- Rowing, rugby, golf, weightlifting, volleyball, gymnastics, judo, tennis, table tennis, baseball, basketball, surfing
- Most involved: first rib
- Sometimes: bilateral

Examination

- Exacerbation of pain with deep breath or cough
- Palpation of crepitus
- The posterolateral aspect of the ribs is subject to the greatest tension forces
- Consider metastases of ribs, consider pathologic fractures
Rib Mobilization: Why?

↑ Rib mobility
↑ Thoracic mobility
↓ Sympathetic activity

Rib Mobilization

1. Soft tissue techniques
2. Costotransverse joint mobilization
3. Costovertebral joint mobilization
Treatment for Ribs

Soft Tissue Treatment
Transverse Stretch to Upper Trapezius and Serratus Posterior Superior Muscles

Picture 344: Slide21

Treatment for Ribs

Soft Tissue Treatment
Transverse Friction Intercostal Muscles

Picture 345: Slide22
Rib Mobilization: Costotransverse

Rotate C-Spine; SB T-Spine
Pillow
Drop UE off mat
Stabilize contralateral side

Alternate Technique

Traction Mobilization in Sitting

The thoracic spine of the patient is locked in flexion, rotation, and contralateral sidebend

(in this picture: flexion, left rotation, and right sidebend)
Rib Mobilization: Costotransverse

Alternate Technique

Traction Mobilization in Supine

Starting Position:
Therapist places the heel of the hand at the rib to be mobilized, just lateral to the costotransverse joint.

End position:
Pressure is exerted through the crossed arms of the patient.
(Note that the patient’s thoracic spine is in extension)
Rib Mobilization: Costovertebral

Elevate UE to motion point
- Ribs 2-6 supine
  - Females: Rib 4 in Sidely
  - Ribs 7-10 sidelying

3 Phases:
- RP Glide
- Breathing P.P
- Contract-relax

For Inspired Rib

1: Mobilize the affected rib caudal
2: Exhale deep + push further
3: Inhale deep + hold + elevate UE further.
4: Mob T-spine into extension
Rib Mobilization: Costovertebral

For Expired Rib

1: Hold rib below down + elevate UE in oscillatory fashion

2: Inhale deep + pull further + abd breathe

3: Exhale deep + push further + abd breathe.

4: Mob T-spine into flexion.
Differential Diagnosis and Manual Therapy of the

Thoracic Spine & Ribs

Local Examination
Segmental Testing

Indications & Interpretation

Local Examination

Indications?

- Basic examination negative
- No longer improvement with total techniques
- No change with total techniques
- Total techniques increased pain
Recurrent Disc Patient Profile

Moderate T-Spine pain:
- Posterolateral: disc, ZAJ, CVJ, CTJ
- Lateral: chronic disc, root irritation
- Anterior: chronic disc

Gradual onset; > 3 mo. duration
Prolonged position → ↑'d pain

BCE Outcomes

1-D provocation: Possibilities
- Only extension: IDD
- Only Flex: IDD
- Only rotation painful: IDD
  - Pain pattern possibilities
    - Band-form
    - Posterior-Lateral
    - Posterior-Central
- Only SB painful: Rib

**Provocation Tests**

Why 3-D? Maximal stress to ZAJ

Extension is unlikely going to stretch the capsule of the ZAJ. Why?

- close-packed
- extension mobility least
  - Spinous Processes
  - Articular Processes

---

**Active / Passive Provocation Tests**

- Flexion, SB (L), Rotation (L)
- Flexion, SB (R), Rotation (L)
- Flexion, SB (R), Rotation (R)
- Flexion, SB (L), Rotation (R)
- Extension, SB (L), Rotation (L)
- Extension, SB (R), Rotation (L)
- Extension, SB (R), Rotation (R)
- Extension, SB (L), Rotation (R)
**Provocation Tests**

3-D in **extension** (repeat to other side)

3-D in **flexion** (repeat to other side)

---

**General Considerations**

- **3-D testing maximally stresses ZAJ capsule and facet surfaces, thus is required to identify these structures as pain generators**

- If one axial rotation in BCE painful, only test those 3D tests that involve this rotation

- When flexion or extension were the only painful test, only test those 3D tests where flexion or extension is part of testing combination

- When BCE is negative, all 3D tests are performed
Segmental Testing

- Thoracic Segmental testing to evaluate whether painful segment is hypomobile or hypermobile
- To assess for hypomobility (most common for thoracic spine), move thoracic spine in coupling fashion to allow as much segmental motion as possible
- Mid thoracic spine coupling in extension varies between subjects (can be ipsilateral or contralateral)
- → need for a testing to determine coupling direction of the mid-thoracic spine


Picture 361: Slide9

Segmental Testing

More often indicated when treating the kinematic chain related to:
- Neck
- Shoulder
- Lumbar
- Hip

T-4 Syndrome

Picture 362: Slide10
Segmental Testing: Silent Zone Testing

Research: Silent Zone Testing

- 42 volunteers:
  19 male, 23 female (age: 18-37 years)
- Denied previous or current vertebral motion-limiting conditions.
- 3 physical therapists (IAOM certification in spinal instruction)
- Marking of T6 Spinoius Process
- Passive Rotation Warm-Up
- Paraspinal Muscle Stretching
**Silent Zone: Tests Phases**

**Phase 1:**
Preferred Rotation

---

**Silent Zone: Tests Phases**

“Couples Opposite”
Decision

= Example:
Left Side-bend
Right rotation

---


Picture 365: Slide13

Picture 366: Slide14
**Pairwise % Agreement for Coupling Direction**


**Coupling Direction Kappa**

- **Pairwise Kappa Range:** .27-.65

<table>
<thead>
<tr>
<th>Kappa</th>
<th>Strength of Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Poor</td>
</tr>
<tr>
<td>0.00 to 0.20</td>
<td>Slight</td>
</tr>
<tr>
<td>0.21 to 0.40</td>
<td>Fair</td>
</tr>
<tr>
<td>0.41 to 0.60</td>
<td>Moderate</td>
</tr>
<tr>
<td>0.61 to 0.80</td>
<td>Substantial</td>
</tr>
<tr>
<td>0.81 to 1.00</td>
<td>Almost Perfect</td>
</tr>
</tbody>
</table>

(Landis & Koch)
Conclusions

- Phase 1: Preferred Rotation may improve the reliability of Phase 2: Coupling Pattern.
- The “Silent Zone” PPI test has sufficient reliability to justify its continued use to aid in differential diagnosis and treatment of ZAJ affictions.
- Summary
  - The “Silent Zone” PPI test has fair to substantial reliability in determining coupling patterns.

Determination of the Coupling in Extension

Perform extension (minimal motion) until cranial spinous process moves
Sidebend away until caudal spinous process moves
Palpate position of both spinous processes, usually a step formation is present as a result of the sidebending
Rotate away until caudal spinous process moves with the induced rotation
Position of both spinous processes (step formation) assessed again

Extension, Left Sidebend, then... 
...Left rotation
Determination of the Coupling in Extension

Perform extension (minimal motion) until cranial spinous process moves
Sidebend toward until caudal spinous process moves
Palpate position of both spinous processes, usually a step formation is present as a result of the sidebending
Rotate away until caudal spinous process moves with the induced rotation
Position of both spinous processes (step formation) assessed again
Both “step formations” are compared, and the series with the largest step will be the coupled motion.

Mobility Testing

Dysfunctions more likely detected in Extension vs. Flexion
  – Sitting or Sidelying
    • 3-D extension
Mobility Testing: Interpretation 1

Sitting & Sidelying
Coupled Extension

- Possibility 1: Unidirectional limitation = Rotation limitation
- Possibility 2: Bidirectional limitation = Extension limitation

Mobility Testing

- Prone
  - Axial rotation
    - Stabilize caudal vertebra, move cranial vertebra
    - Test all rotations in one direction, comparing segment to segment
    - Then all rotations to the other direction
  - Spring testing

Picture 373: Slide21

Picture 374: Slide22
Mobility Testing: Interpretation

Suggestions

Segmental Axial Rotation
- Treat each segment, each direction that is limited; Treat both directions even if (1) rotation direction is limited

Spring Test
- Spinous Process Painful ➔ Pain relief (e.g., Local traction) at segments above and below
- If Spinous process (-) then test at T-Process ➔ If painful then pain relief at segments above and below
- If up to (3) processes painful ➔ local disorder and treat each segment & one above and one below
- If MANY segments suspect sensitization
Management

Indications
Internal Disc Disruption, IDD
Zygapophyseal Joint, ZAJ capsular disorder
ZAJ cartilage disorder

Management

Indications
Management of Chronic Thoracic Disorders
   Needed thoracic movement for unloading the following pain-generating disorders: IDD & ZAJ

Management of Chronic Disorders of the UE
   – Needed thoracic movement for shoulder elevation
   – Addresses ↑’d sympathetic activity

Management

Indications

Management of Chronic Headache
- Addresses ↑’d sympathetic activity

Management of FVBI
- Addresses ↑’d sympathetic activity


Management: CPR

A seated “distraction” manipulation, a supine upper thoracic spine manipulation, and a middle thoracic spine manipulation.

The following 6 variables predicted positive outcome of thoracic manipulations:

1. symptom duration of <30 days
2. no symptoms distal to the shoulder
3. Subject reports that looking up does not aggravate symptoms
4. FABQPA score of < 12
5. Diminished upper thoracic spine kyphosis (T3-T5)
6. Cervical extension of <30 degrees


Management: Research

60 subjects with neck pain

The results suggest that thoracic spine thrust mobilization/manipulation results in significantly greater short-term reductions in pain and disability than does thoracic nonthrust mobilization/manipulation in people with neck pain

Management: Posture

Changing posture had an effect on all components of posture measured (P<.001) and these changes were associated with a significant increase (P<.001) in the range of motion in shoulder flexion and abduction in the plane of the scapula.

The findings of this investigation suggest that changing 1 or more of the components of posture may have a positive effect on shoulder range of movement and the point at which pain is experienced.


Management

21 subjects with shoulder pain were treated during a single treatment session with high-velocity thrust manipulation to the thoracic spine or upper ribs.

Outcome:
51% (3 cm) reduction in shoulder pain
Increase shoulder ROM (30 degrees)

Conclusion: Regional interdependence between the thoracic spine, upper ribs, and shoulder.

Management

Meta-analysis

There is sufficient evidence to support the use of thoracic spine manipulation for specific subgroups of patients with neck conditions.

Further studies needed to examine the effectiveness of thoracic spine manipulation to treat shoulder conditions and the effectiveness of TSM on neck conditions with long-term follow-up studies.


Management

Do patients receiving thoracic thrust manipulation exhibit tolerance to repeated applications in acute mechanical neck pain?

N=45 patients

Patients receiving thoracic manipulation do not exhibit tolerance to repeated applications with regard to pain and cervical ROM in patients with acute mechanical neck pain.

Segmental Management

Methods
Pain Relief: Oscillatory joint specific techniques, JST in the painful segment
   – Grades 1 and 2

Restoration of Mobility
   – Grades 3 and 4

Management: Segmental Techniques

Suggestions for Pain Relief
• Oscillatory in nature
• Performed at beginning of ROM
• Performed with large amplitude
• Performed with patient normally breathing
Management: **Segmental Techniques**

**Suggestions for Improving Mobility**
- Oscillatory or manipulative in nature
- Performed at end of ROM
- Performed with small amplitude
- Performed after patient exhales deeply
- Use towel roll or pillow to support the patient


Picture 389: Slide37

---

Management: **Segmental Techniques**

**Local Segmental Traction Techniques**
- **Prone = Preferred Technique**
  - Pressure on the transverse process of the caudal vertebra
  - Direction is 60° from kyphosis
  - Warm up
  - Start with this technique in bilateral limitations

Picture 390: Slide38
Management: Segmental Techniques

Local Segmental Traction Techniques
- Sitting = “Gegenhalten” technique
  → Move the cranial vertebra in a dorsal cranial direction – use the wedge to stabilize TP of caudal vertebra

Additional Comments:
- Indication: Thoracic/low lumbar
- Head Position:
  - Thoracic: flex, extend
  - Low lumbar: flex, extend
- Not recommended if cracking

Picture 391: Slide39

Management: Segmental Techniques

Local Segmental Traction Techniques
- Supine
  → wedge on caudal vertebra → push through the arms of the patient in dorsocranial direction

Picture 392: Slide40
Management: Segmental Techniques

Local Segmental Rotation Techniques

- Prone = Preferred
  - Rule out disc!
  - PT stands on the side of the rotation to be performed
  - PT arms straight
  - Pressure of PT on transverse process
  - Mobilize cranial segment 1st

- Start with treating the cranial segment in rotation when a uni-lateral cluster of segmental limits have been found.
Management: Segmental Techniques

Local Segmental Rotation Techniques
- Techniques
  - Supine
    - *Pistol grip technique*
    - PT stands on opposite side of rotation
    - Thenar eminence on caudal vertebra (TP)
    - Middle phalanx middle finger on cranial vertebra (TP)
    - Upper spine flexed to the segment treated
    - Segment treated in neutral position

---

Management: Segmental Techniques

Thoracic Manipulation for Rotation
Pistol Grip Technique-Thoracic spine manipulation results in immediate analgesic effects in patients with mechanical neck pain.

---

Management: Segmental Techniques

Local Segmental Rotation Techniques

- Sitting
  
  http://www.youtube.com/watch?v=_e6DYPdlamA

  - Patient at end of treatment table straddles table
  - Patient arms crossed
  - PT behind patient with 1 hand around thorax from front
  - PT with ulnar aspect of hand on the cranial rib
  - PT sidebends the lumbar & thoracic segments below the treated segment in opposite direction of the rotation
  - Rotation mob-manip while extending the trunk with axial separation and exhalation

Management: Additional Recommendations

FOR IDD Pain-Total Techniques First

- Axial separation in neutral
- 3-D axial separation

FOR ZAJ Pain

- Local dorsoventral mobilization
- Oscillatory local traction first
Management: **Mobilization Techniques**

**Local Mobilization Techniques**

- **Extension Technique**
  - Sitting
  - Prone
- **Neuromuscular Re-Education**
  - Sitting
  - Best used for upper to midthoracic

**Best** = mobilize extension limitations of mid to lower thoracic and Neuromuscular re-education
Case Study 1

History

Patient is a 38-year-old female teacher who complains of diffuse midline thoracic pain. Onset of pain was 16 years earlier when she fell down a flight of stairs, landing on her back while holding a 50-pound box.

Pain is rated a 6 to 8/10 on the visual analog scale. Aggravating factors for her pain include sitting for long periods of time and lying supine. She describes her pain as a “knife being shoved” into her back. She has had to stop sitting with her second graders on the floor. Symptoms are generally better in the morning and worse at night. She has had to give up exercising due to pain and feels that her general level of activity has decreased over the years.

Since her injury, the patient has had physical therapy, which has consisted of heat application, cold application, and some exercises. This has provided temporary relief of her pain. In addition she has had chiropractic care since her injury that initially provided her with relief, however recently only helps her feel less stiff.

Past Medical History:

Patient denies any systemic diseases, and states she is in otherwise good health.

Inspection

Unremarkable

Screening

Thoracic range of motion:

Flexion: within normal limits in terms of range of motion, and painless. Neri is negative.

Extension: mildly limited in range of motion, and provokes midline thoracic pain, 7/10.

Sidebending: WNL bilaterally.

Rotation, right: mildly limited in range of motion, and provokes midline thoracic pain, 7/10. Cervical flexion from this position increases pain intensity (positive Neri), 8/10.

Rotation, left: within normal limits in range of motion, but provokes midline thoracic pain, 6+/10. Neri is negative

Resisted testing: WNL

Reflexes: WNL

Spring testing: local pain is provoked with testing of both the transverse and spinous process at T11, T12, and L1.

Special Tests

3-D extension testing demonstrates hypomobility, bilaterally, at T9-10 and T10-11. Increased rotation mobility, laxity, is found with rotation testing and 3-D extension testing at T12-L1.

Additional Diagnostic Information

X-rays, taken within the previous year, show lipping at the T12-L1 segment.
<table>
<thead>
<tr>
<th>Basic Functional Exam: Thoracic Spine (T/S)</th>
<th>Examiner:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Name:</td>
<td>Date of Birth:</td>
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### Inspection

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<tr>
<th>Active Motions in Sitting</th>
<th>Limitation</th>
<th>Pain Level</th>
<th>Location</th>
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<td>Forward Flexion</td>
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<tr>
<td>Extension</td>
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<td>Left Sidebend</td>
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<td>Left Axial Rotation</td>
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<td>with Cervical Flexion (Neri)</td>
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<tr>
<td>Right Axial Rotation</td>
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<tr>
<td>with Cervical Flexion (Neri)</td>
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</tr>
<tr>
<td>Sidebend</td>
<td>✔️</td>
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</tr>
<tr>
<td>Extension</td>
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### Passive Motions in Sitting

<table>
<thead>
<tr>
<th>Passive Motions in Sitting</th>
<th>Limitation</th>
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<th>Location</th>
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<tr>
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</tr>
<tr>
<td>with Cervical Flexion (Neri)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Right Axial Rotation</td>
<td>10%</td>
<td>± ++</td>
<td>1</td>
</tr>
<tr>
<td>with Cervical Flexion (Neri)</td>
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</tr>
<tr>
<td>Sidebend</td>
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<tr>
<td>Extension</td>
<td>10%</td>
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### Resisted Motions in Sitting

<table>
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### Reflex Testing in Sitting

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<th>R</th>
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<td>O Flexion with Right Rotation</td>
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### Reflex Testing in Supine

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### Active Motions in Prone

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| Passive Motions in Prone

### Passive Motions in Prone

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| Resisted Testing (O): Prone

### Dorsoventral Provocation Tests

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<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>T7</th>
<th>T8</th>
<th>T9</th>
<th>T10</th>
<th>T11</th>
<th>T12</th>
<th>L1</th>
<th>L2</th>
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<td>T3</td>
<td>T4</td>
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<td>T10</td>
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<td>T3</td>
<td>T4</td>
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<td>T9</td>
<td>T10</td>
<td>T11</td>
<td>T12</td>
<td>L1</td>
<td>L2</td>
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PT Name: ___________________________  PT Signature: ___________________________

OCD 2003
### Basic Functional Exam: Thoracic Spine (T/S)

#### Extra Tests:

<table>
<thead>
<tr>
<th>Neural Tests in Long Sitting</th>
<th>First Motion</th>
<th>Second Motion</th>
<th>Location</th>
<th>Braggard</th>
<th>Neri</th>
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<tr>
<td><strong>Slump</strong></td>
<td>DE + Knee Ext</td>
<td>Cervical Flexion</td>
<td>Change in Pain</td>
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<tr>
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<td>± + ++ +++</td>
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<td>± + ++ +++</td>
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</tr>
</tbody>
</table>

#### Assessment:

1° Pain Generators

2° Pain Generators

Local Joint Dysfunctions

Neurological Signs

PT Name: ____________________________  PT Signature: ____________________________

#### Symbol Key:

- **√**: Not limited or Painful
- **±**: Very Minimal
- **+**: Minimal
- **++**: Moderate
- **+++**: Severe
- **Ω**: Resisted
- **F**: Force
- **E**: Endfeel
- **Tx**: Treatment
- **= Left Rotation**
- **= Right Rotation**
- **= Left Sidebend**
- **= Right Sidebend**
- **= Flexion**
- **= Extension**
- **= Hypomobile**
- **= Hypomobile**
- **= Pain**
- **= Soft Endfeel**
- **= Firm Endfeel**
- **= Hard Endfeel**
- **= Joint Specific Mobilization**
- **= Soft Tissue Mobilization**
- **= Lymph Drainage Massage**
- **= Neuromuscular ReEducation**
- **= Pain**
- **= PCT**
- **= NMR**
- **= SMR**
- **= Sensorimotor ReEducation**
- **= Trunk Stabilization**
- **= Within Normal Limits (WNL)**
- **= Costovertebral Joint (CVJ)**
- **= Costotransverse Joint (CTJ)**
- **= Cervicothoracic Junction (CTJ)**
- **= Joint Specific Mobilization (JSM)**
- **= Lymph Drainage Massage (LDM)**
- **= Internal Disc Disruption (IDD)**
- **= Preposition (pp)**
**Case Study 2**

**History**

Patient is a 40-year-old male mechanic who is seen today with severe, debilitating thoracic spine pain. Symptoms began approximately 1 week ago, and he is unable to determine a precipitating event. He noticed some general thoracic discomfort, with radiating pain to the right after work one day, and by the next morning he was unable to get out of bed. He has had to stop working because of the severity of his pain.

Symptoms increase with any activity, such as sitting, standing, and bending. He notes that he is unable to stand upright without severe pain. He has to constantly change positions. He is able to turn his head and move his arms without an increase in symptoms, but notes that he cannot lift any objects without pain. Transitional movements are particularly painful for him, such as moving from supine to sitting, or sitting to standing. Sometimes, he notices, it hurts to take a deep breath.

Patient rates his pain at an 8 to 9/10.

**Past Medical History:**

Patient does not smoke. He does not exercise regularly. He has no other significant medical problems. He does have a history of a right shoulder rotator cuff repair, 3 years ago.

**Inspection**

During the history, the patient has to constantly change positions and move about the room. He is forward bent, and in what appears to be significant pain.

**Screening**

Cervical range of motion: WNL

Bilateral arm elevation: WNL

Thoracic range of motion:

Flexion: limited approximately 20% with provocation of severe pain in the mid-thoracic region and radiating to the right. Neri further increases the intensity of the pain, 9+/10

Extension: limited approximately 90%, and provokes severe midline thoracic pain, 9+/10.

Sidebending: mildly limited bilaterally, about 20% and provokes a mild increase in pain, 8+/10.

Rotation, right: limited approximately 20%, and provokes midline thoracic pain, 8+/10. Cervical flexion from this position increases pain intensity (positive Neri), 9/10.

Rotation, left: limited approximately 70% with provocation of severe midthoracic symptoms and radiating pain to the right, 9+/10. Neri is so painful that it is almost unbearable for the patient.

Resisted testing: WNL

Reflexes: WNL
**Special Tests**

Spring testing: Mild local pain is provoked with spring testing at the spinous processes at T4, T5, T6, and the most severe pain (at midline and radiating to the right) is provoked at T8 and T9.

**Additional Diagnostic Information**

MRI reveals a disc bulge at T4-5 and multiple levels of disc degeneration throughout the thoracic spine.
### Basic Functional Exam:

**Thoracic Spine (T/S)**

<table>
<thead>
<tr>
<th>Extra Tests:</th>
<th>First Motion</th>
<th>Second Motion</th>
<th>Location</th>
<th>Braggard</th>
<th>Neri</th>
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<tr>
<td>Right Axial Rotation and Right Leg</td>
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### Limitation | Pain Level | Location

<table>
<thead>
<tr>
<th>Limitation</th>
<th>Pain Level</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>± + ++ +++</td>
<td>± + ++ +++</td>
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</table>

### Assessment:

#### 1° Pain Generators

Based On #(s):

#### 2° Pain Generators

Based On #(s):

#### Local Joint Dysfunctions

Based On #(s):

#### Neurological Signs

Based On #(s):

---

**PT Name:** ____________________________  **PT Signature:** ____________________________

---

### Symbol Key:

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- `±` = Very Minimal
- `+` = Minimal
- `++` = Moderate
- `+++` = Severe
- `Ω` = Resisted
- `F` = Force
- `E` = Endfeel
- `Tx` = Treatment
- `F` = Force
- `E` = Endfeel
- `Tx` = Treatment

- `= Left Rotation`
- `= Right Sideband`
- `= Flexion`
- `= Extension`
- `= Hypomobile`
- `= Hypermobile`
- `= Pain`
- `= Preposition`

- `E 0-33` = Soft Endfeel
- `E 34-66` = Firm Endfeel
- `E 67-100` = Hard Endfeel
- `JSM` = Joint Specific Mobilization
- `STM` = Soft Tissue Mobilization
- `LDM` = Lymph Drainage Massage
- `NMR` = Neuromuscular ReEducation
- `PCT` = Preposition

- `WNL` = Within Normal Limits
- `CVJ` = Costovertebral Joint
- `CTJ` = Costotransverse Joint
- `ZAJ` = Zygapophyseal (Facet) Joint
- `UVJ` = Uncovertebral Joint
- `IDD` = Internal Disc Disruption
- `pp` = Preposition

---

OCD 2003
Case Study 3

History

Patient is a 47-year-old female who is seen for complaints of severe right ventrolateral trunk pain. Approximately 4 months earlier she was hospitalized for pneumonia. During her hospitalization, a right lung biopsy was performed where her ribs were spread to perform surgery on the right side of her thorax. A tube was placed in her chest cavity for drainage of fluid. This tube remained for four to five days. She reports this was the onset of her current pain problems.

Patient describes her pain as a “hot spot” along the costal arch, ventrally on the trunk, at the right side. Symptoms radiate from there up to the sternum and also down around the right side of her trunk. The pain appears to cover the area of approximately the T6 through T10 distribution on the right side of the thorax. Visual analog score is 5/10 for average intensity, 8/10 upon aggravation, and is currently 2/10.

Aggravating factors to the pain include sitting, driving, walking, lifting, coughing, sneezing, and taking deep breaths. She also notes that if she eats a very full meal that her symptoms will flare up.

Past Medical History:

Patient is in otherwise excellent health. This is his first orthopedic injury.

Inspection

The patient is obese. There is a well-healed incision located at the dorsal trunk, at approximately the T6 to T8 area, below the right scapula. (This is from the lung biopsy.) There is also an area of scar adhesion and dimpling of the skin on the right side of the thorax at approximately the T8 to T10 level, about one inch in width, on the right lateral thorax inferior to the axilla. (This is from the drainage tube.)

Screening

Cervical spine range of motion is within normal limits and painless.

Thoracic range of motion, active and passive:

Flexion (active only): range of motion is WNL and painless.

Extension: range of motion is WNL and painless.

Sidebending, left: range of motion is WNL and painless.

Sidebending, right: range of motion is WNL, but patient complains of a sharp pain at the right lower anterior portion of the ribs, 6/10.

Rotation left: range of motion is WNL and painless.

Rotation, right: range of motion is WNL, but patient complains of a pulling sensation along the right lower anterior portion of the ribs, 3/10.

Resisted testing: WNL.

Reflexes: WNL

Dural tension testing: the patient’s slump testing performed in multiple positions are all negative.

Spring testing: WNL
**Additional Diagnostic Information**

Rotation left: range of motion is WNL and painless.
Rotation, right: range of motion is WNL, but patient complains of a pulling sensation along the right lower anterior portion of the ribs, 3/10.
Resisted testing: WNL. Reflexes: WNL
Dural tension testing: the patient’s slump testing performed in multiple positions are all negative.
Spring testing: WNL

**Additional Diagnostic Information**

X-rays and MRI are negative.

**Special Tests**

The hook maneuver, at the 9th rib, provokes a sharp painful clicking, 5/10.

---

<table>
<thead>
<tr>
<th>Basic Functional Exam:</th>
<th>Thoracic Spine (T/S)</th>
<th>Examiner:</th>
</tr>
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<tbody>
<tr>
<td><strong>Inspection</strong></td>
<td></td>
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<tr>
<td>Active Motions in Sitting</td>
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<td>Pain Level</td>
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<td>3 Extension</td>
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<td>[ ]</td>
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<td>++</td>
</tr>
<tr>
<td>14 Right Axial Rotation</td>
<td>[ ]</td>
<td>±</td>
<td>++</td>
</tr>
<tr>
<td>15 with Cervical Flexion (Neri)</td>
<td>[ ]</td>
<td>±</td>
<td>++</td>
</tr>
<tr>
<td>16 Sidebend</td>
<td>✓</td>
<td>±</td>
<td>++</td>
</tr>
<tr>
<td>17 Extension</td>
<td>✓</td>
<td>±</td>
<td>++</td>
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<table>
<thead>
<tr>
<th>Resisted Motions in Sitting</th>
<th>Strength</th>
<th>Pain Level</th>
<th>Location</th>
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<tbody>
<tr>
<td>18 Left Rotation</td>
<td>✓</td>
<td>±</td>
<td>++</td>
</tr>
<tr>
<td>19 Left Sidebend</td>
<td>✓</td>
<td>±</td>
<td>++</td>
</tr>
<tr>
<td>20 Right Rotation</td>
<td>✓</td>
<td>±</td>
<td>++</td>
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<table>
<thead>
<tr>
<th>Reflex Testing in Sitting</th>
<th>Reflex</th>
<th>L</th>
<th>R</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Patellar Tendon</td>
<td>(●)</td>
<td>+</td>
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<tr>
<td>Achilles Tendon</td>
<td>(●)</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Babinski</td>
<td>(●)</td>
<td>-</td>
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<table>
<thead>
<tr>
<th>Resisted Motions in Supine</th>
<th>Strength</th>
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<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>22 Flexion</td>
<td>✓</td>
<td>±</td>
<td>++</td>
</tr>
<tr>
<td>23 Flexion with Left Rotation</td>
<td>✓</td>
<td>±</td>
<td>++</td>
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<thead>
<tr>
<th>Reflex Testing in Supine</th>
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<th>L</th>
<th>R</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Abdominal Reflex</td>
<td>(●)</td>
<td>+</td>
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<thead>
<tr>
<th>Active Motions in Prone</th>
<th>Limitation</th>
<th>Pain Level</th>
<th>Location</th>
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<td>26 Extension</td>
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<thead>
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<table>
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<tr>
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<th>Strength</th>
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<td>28 Extension</td>
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<table>
<thead>
<tr>
<th>Dorsoventral Provocation Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring Testing at SP:</td>
</tr>
<tr>
<td>Spring Testing at TP:</td>
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</tbody>
</table>

PT Name: ___________  PT Signature: ___________
## Basic Functional Exam: Thoracic Spine (T/S)

### Extra Tests:

<table>
<thead>
<tr>
<th>Neural Tests in Long Sitting</th>
<th>First Motion</th>
<th>Second Motion</th>
<th>Location</th>
<th>Braggard</th>
<th>Neri</th>
<th>Change in Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right Axial Rotation and Right Leg</td>
<td>± * ++ +++</td>
<td>± * ++ +++</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left  Axial Rotation and Right Leg</td>
<td>± * ++ +++</td>
<td>± * ++ +++</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Right Axial Rotation and Left Leg</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Left  Axial Rotation and Left Leg</td>
<td>± * ++ +++</td>
<td>± * ++ +++</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right Axial Rotation and Both Legs</td>
<td>± * ++ +++</td>
<td>± * ++ +++</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left  Axial Rotation and Both Legs</td>
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<table>
<thead>
<tr>
<th>Limitation</th>
<th>Pain Level</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>- ± * ++ ***</td>
<td>- ± * ++ ***</td>
<td></td>
</tr>
</tbody>
</table>

### Assessment:

- **1° Pain Generators**: Based On #(s):
- **2° Pain Generators**: Based On #(s):
- **Local Joint Dysfunctions**: Based On #(s):
- **Neurological Signs**: Based On #(s):

### Symbol Key:

- √ = Not limited or Painful
- ± = Very Minimal
- + = Minimal
- ++ = Moderate
- +++ = Severe
- Ω = Resisted
- F = Force
- E = Endfeel
- Tx = Treatment
- DE + Knee Ext = Cervical Flexion
- Change in Pain
- X Rays
- MRT

**PT Name:** __________________________  **PT Signature:** __________________________

**OCD 2003**
Case Study 4

History

Patient is a 62-year-old female homemaker who is seen for a 30-year history of severe mid- to upper thoracic pain on the right. Symptoms began after undergoing a thoracotomy for a tumor in her lungs. At that time she was told that she probably had 5 months to live, and so she began to travel. She attributes the fact that she lived to this traveling. Unfortunately after the initial surgical soreness wore off, the patient was left with unrelenting right thoracic pain. Symptoms were so severe that she took up flying small airplanes, and this is the only time when she is able to tolerate her pain.

Past Medical History:

Patient has undergone trigger point injections, physical therapy that involved stretching and upper body strengthening exercises, and multiple medications, all without success.

Her health is otherwise good.

Inspection

A deep, oblique 7-inch scar is evident over the right paraspinal region just medial to the superior half of the right scapula.

Screening

Cervical range of motion: WNL

Bilateral arm elevation: Elevation of the right arm provokes increased pain at the right upper thoracic region, 8+/10.

Thoracic range of motion:

Flexion: WNL, Neri is negative.

Extension: WNL.

Sidebending, right: WNL

Sidebending, left: slight increase in symptoms, 8+/10.

Rotation, right: WNL

Rotation, left: WNL.

Resisted testing: WNL

Reflexes: WNL
**Special Tests**

Spring testing: Negative.

Position testing of the ribs: severely painful, 9+/10, and elevated 4th and 5th ribs on the right.

Spring testing of the costotransverse joints: severely painful, 9+/10, and hypomobile 4th and 5th ribs on the right.

Moderate muscle splinting is noted underneath the scar site, and particular tenderness is found at the intercostal region between the 4th and 5th ribs at their dorsal aspect.

**Additional Diagnostic Information**

All imaging negative.
<table>
<thead>
<tr>
<th>Neural Tests in Long Sitting</th>
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<th>Location</th>
<th>Braggard</th>
<th>Neri</th>
<th>Change in Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slump</td>
<td>DE + Knee Ext</td>
<td>Cervical Flexion</td>
<td></td>
<td>• ↑ · ↓</td>
<td>• ↑ · ↓</td>
<td></td>
</tr>
<tr>
<td>Right Axial Rotation and Right Leg</td>
<td>± ++ +++</td>
<td>± ++ +++</td>
<td>• ↑ · ↓</td>
<td>• ↑ · ↓</td>
<td>• ↑ · ↓</td>
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**Assessment:**

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Neurological Signs | Based On #(#s):

PT Name: ___________________________  PT Signature: ___________________________
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